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THESIS

VALIDATION OF THE UNITED STATES MARINE CORPS QUALIFIED CANDIDATE POPULATION MODEL

by

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March 2003

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VALIDATION OF THE UNITED STATES MARINE CORPS QUALIFIED CANDIDATE POPULATION MODEL

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ABSTRACT

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TABLE OF CONTENTS

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LIST OF FIGURES

LIST OF TABLES

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EXECUTIVE SUMMARY

The United States Marine Corps obtains a majority of its officers from the population of college students within the United States and its territories. As such, it dedicates significant resources to recruiting on college campuses. During the late 1990s, Recruiting Command officials decided to develop a new model of the market.

During 2001, the Center for Naval Analysis modeled the college population that is qualified to enter these Marine commissioning programs. Marine Corps Recruiting Command planners have since used the model to allocate recruiting goals and resources. In the meantime, they requested an evaluation and expansion of the model.

The sponsors of this research wanted several results. First, they wanted to know if the model's methodology and assumptions were sound, and they requested a validation of the model's output. The sponsors noted three limitations of the model. The model does not account for the propensity of students at a particular institution to join the Marine Corps. The model also is static: its predictions are based on late 1990s data, and do not change with changes in the college population. And, while the Marine Corps markets three programs to college students, the model only offers a measure of students qualified for one. Hence the sponsors asked that the model's notional output be refined to forecast, through fiscal year 2004, the population that is both qualified and interested to enter any one of the three programs.

This study begins by finding that model validation processes within the operations research community employ strict standards. There also exists little published research into the propensity of college students to enter the military. U.S. Army officer recruiters, though, have managed to incorporate a measure of propensity into their model. And while there exists a wealth of research into characteristics and values of college students, information needed to validate the model tends to be held in confidence due to proprietary and privacy concerns. It was also noted that the behavior of college students has changed markedly since the guidelines for these recruiting programs were published during 1989, and that the market may have contracted during the 1990s.

The study did obtain some data. A census of officer recruiters netted 41 distinct responses from a population that effectively numbered between 55 and 65. A survey of four-year colleges yielded 45 valid observations from 290 contacts. It was found, though, that few colleges are interested in or capable of measuring their qualified population to the standards of a validation. Nearly every observation required imputation to arrive at a count equivalent to that produced by the model. The actual qualified population could not be counted.

The verification effort found that the model performs as discussed in the literature that accompanied the model. This research did encounter some minor omissions from the database, and offers that the model could be improved by inclusion of colleges in Puerto Rico and Guam. However, the assumptions on which the model was based are plausible. Incidentally, this study found that SAT and ACT thresholds applied by the Marine Corps disagree with the standards recognized by the College Board, creating a situation in which students from Midwestern colleges may face a stricter standard than students elsewhere, and in which students recruited over the past few years come from a different test-score percentile than students from years prior to 1997.

Because the actual qualified population could not be counted, this study could not validate the model. It could, however, estimate the model's accuracy by comparing its output to imputed observations. On average, the model's estimates exceed the enhanced observations by five to twenty percent, if one accepts students who complete their degrees in five years as eligible. If one counts only four-year completions, the model's estimates then interact with the competitiveness of individual schools, over-counting the attendance-eligible at schools with higher migration rates by at least forty percent. The static nature of the model makes it susceptible to variation in local college populations, which can occur quite rapidly. When considered by ethnic population group, the model appears to consistently overstate counts of qualified Black students by perhaps as high as ninety percent. Otherwise, the comparison suggests that the model provides a reasonable approximation of the qualified population.

This study proposes that propensity may be measured over time, in a given geographic entity, with ordinal ranking of median times between applicant commitment

(contract date) and the scheduled date to begin training. The study found support for this method through descriptive, regression tree and classification tree techniques.

To expand the model, the study increased the number of colleges within the database and populated it with U.S. Department of Education enrollment and completion counts going back to 1996. The effort then applied forecasting techniques to the data in order to obtain over 50,000 point forecasts that will enable planners to consider the qualified population, at 1,044 colleges, for any of four ethnic populations, for any of three officer recruiting programs, through fiscal year 2004.

In conclusion, MCRC officials may place confidence in the methodology developed by Jareb and Parker, though its output must be considered under some conditions. Attendance and test-score eligibility rates can change rapidly, jeopardizing the accuracy of some forecasts. Barring this local variability, the model seems to measure proportions of qualified candidates reasonably well. Given this local variability, the model may underestimate counts at certain schools, though on average the model appears to overestimate the aggregate qualified population by five to twenty percent. Two exceptions stand out: Hispanic QCP within the 6th District appears understated due to exclusion of Puerto Rican colleges from the model, and counts of qualified Black students at any college appear overstated by perhaps ninety percent due to the use of test-score eligibility criteria on which black students routinely score, on average, significantly lower than the population used to establish score-eligibility percentiles. The enhanced spreadsheet application developed in connection with this research applies the Jareb-Parker methodology to a larger database that includes Puerto Rican colleges.

Future analysis of officer recruiting would benefit if the Marine Corps conformed to federal and academic practice of using U.S. Department of Education codes instead of codes unique to the Marine Corps when recording an applicant's education experiences. It would also benefit if recruiters and the medical processing system kept record of students who initiate the application process rather than those who successfully complete it. In light of significant changes to student behavior during the past fifteen years and consistent differences in performance of students on the SAT, by race, the findings of this

study suggest that the recruiting force would benefit from a review of attendance and test-score eligibility guidelines.

I. INTRODUCTION

A. BACKGROUND

The Marine Corps is unique among the nation's military services in that a majority of its officers are drawn from the current and recently graduated college population, rather than from the Reserve Officers Training Corps (ROTC) or a service academy. The Defense Data Manpower Center (DMDC) estimates that in FY99, 63 percent of United States Marine Corps (USMC) officer accessions entered through Officer Candidates School (OCS), versus only 22 percent DoD-wide (DMDC, 1999). These civilians obtain their commissions through OCS at Quantico, Virginia. The Marine Corps operates two programs for these candidates at OCS. One—the Platoon Leader's Course (PLC)—trains college students, prior to starting their senior year; the other—Officer Candidates Course (OCC)—focuses on seniors and recent college graduates.

This research verifies, validates and expands a model used by the USMC that identifies a critical population within its officer recruiting market. Mr. Anton Jareb and Ms. Laura Parker of the Center for Naval Analysis (CNA) proposed this model during April 2001. The Marine Corps Recruiting Command (MCRC) adopted the model and used its output as a basis for allocating fiscal year 2002 officer recruiting goals to its subordinate entities. Output from the model also supports decisions to reposition officer recruiting resources. The model may be used by recruiters to explore the ethnic distribution of potential candidates in their territories. This paper refers to this model as the "Jareb-Parker model." (MCRC, 2001)

The Marine Corps assigns nearly 80 officers for the sole purpose of pursuing qualified PLC and OCC applicants. The Jareb-Parker model supports their efforts by estimating, by race, the available number of mentally qualified male bachelor's degree recipients produced annually by United States colleges and universities. This output is labeled "Qualified Candidate Population" (QCP). The model bases QCP for a given institution on enrollment, selectivity and graduation data obtained from the U.S. Department of Education and from commercial rankings of colleges and universities.

B. OBJECTIVES

This research attempts to achieve three objectives.

1. Verify the Jareb-Parker Model

First, the research attempts to verify this model developed by Jareb and Parker and currently in use at MCRC. Verification entails review of the model's design and assumptions to determine how well they address the problem. This process also compares the data within the model against its source, to ensure the information was accurately transcribed.

2. Validate the Jareb-Parker Model

The research next attempts to validate the output of the model. A review of related literature found many opinions on the definition of validity. This paper defines "validity" as the ability to measure that quantity which one intends to measure. It attempts to validate the model with the strict procedures encouraged by literature in the operations research community. More specifically, the research accepts the model as valid if its output and proportion of ethnic distribution are accurate to within ten percent of most recently available observations.

The figure of ten percent was discussed and agreed upon at an interim progress review during March 2002. Representatives from both MCCDC and MCRC attended. It was felt that this amount of error retained enough credibility in its output to support its intended uses, while allowing for a model's inherent nature as an approximation of reality.

3. Expand the Jareb-Parker Model

a. Expand the Model To Include College Cohorts

Next, the research attempts to refine the output of the model by stratifying QCP by "level" of college attendance: i.e., freshman QCP, sophomore QCP, and so on.

b. Expand the Model To Include a Propensity Measure

The research then attempts to identify a measure of propensity to enter Marine officer commissioning programs, and to incorporate this propensity measure into the model.

c. Forecast Population Shifts

Finally, the research forecasts the size of the qualified and interested officer recruiting market in FY 2002, 2003 and 2004. A computer application was developed to enable others to tailor forecasts to regional groupings of colleges.

C. RESEARCH QUESTION

This research seeks to answer the question, "Is the Jareb-Parker model useful in deciding where to focus officer recruiting efforts?" In other words, does the model represent the college population well enough to enable informed decision making by those involved in Marine officer recruiting? An answer to this question depends on the availability of acceptable data from colleges and universities. The model will certainly be useful if it can be shown to be valid. The research also seeks to answer the question, "Can this model be improved by considerations of propensity?" If so, is data available to support a credible measurement of propensity in the college population? Finally, the research considers how the model's forecasts may change over the near future.

D. SCOPE, LIMITATIONS AND ASSUMPTIONS

1. Scope

The Department of Navy operates several programs that commission Marine officers, including a service academy, the Navy ROTC, reserve officer programs (PLC and OCC) and enlisted commissioning programs. This study considers only two of these programs: PLC and OCC.

These two programs are open to various levels of college students and college graduates. In the process of validating the model, this study narrows its focus to students attending regionally accredited, bachelor's-awarding colleges within the United States. Two-year colleges, law schools, specialty schools, and the young, skilled labor force are thus beyond the scope of this project. Colleges located within U.S. Territories are discussed in the sections that cover verification and expansion of the model. And unless otherwise noted, enrollment figures pertain to male U.S. citizens.

Finally, all mention of the SAT (formerly known as the Scholastic Aptitude Test) refers to the SAT I version of the test.

2. Limitations

The data used in this study were obtained through a survey, a census and from five existing databases. The following section describes the limitations encountered with each source.

a. Data Collected by Survey of Colleges

This study contacted 290 U.S. colleges for information that would support validation of the model.

(1) Opportunity Sample by Institution Control. Field measurements of QCP may be biased because of different policies towards publishing admission test scores. Public institutions tend to be more open with this information. Institutions under private control, however, tend to regard this same information as proprietary, and so tend to release it only to the U.S. Department of Education or private consortia, where its confidentiality is safeguarded. Accordingly, the data collected from colleges do not represent a simple random sample. Privately controlled institutions comprise 53 percent of Jareb and Parker's database, but only 46 percent of the sample of observations. The sample is biased towards public universities, at the expense of private colleges.

(2) Opportunity Sample by Enrollment Requirement. The sample of QCP field measurements is also limited by variable admissions requirements at U.S. postsecondary institutions. In developing their model, Jareb and Parker identified seven different approaches U.S. colleges take towards admission test scores. The Jareb-Parker model hence applies any of seven different methods to estimate the level of mental qualification in a given student body. Some of these methods have a regional flavor: public schools in the Mississippi and Ohio River basins favor the American College Test (ACT) over SAT scores, for instance. Some of these methods are influenced by institution size or control. This study was unable to obtain large enough samples of data from schools applying some of these methods, so the study is limited to examining the performance of the two most common methods employed by the model: SAT Distribution and ACT Distribution. These two methods, though, account for 87 percent of the cumulative national QCP.

(3) Restricted Sample by Institution Size. The sampling method used to obtain college estimates of QCP was restricted to larger colleges. Even within the sampling frame, though, many colleges proved unable or unwilling to provide information supporting this research. Smaller institutions tend not to employ full-time analysts. Maintenance and analysis of the student database at such schools, in fact, is frequently a collateral duty of the registrar, academic provost or information technology director. Such schools tended to lack enough dedicated analysts to support this research. Larger institutions, on the other hand, normally employ full-time analysts in either an office of institutional research or an office of planning, but receive more requests for information, and have more complex data sets to manage. Some such institutions declined to participate because of inadequate resources, and many others declined due to policies that prevent work in which the institution gains no tangible "value-added." Some private institutions replied that their attorneys counseled against participation in this survey. Chapter V discusses in detail this bias towards larger schools.

(4) Limits on Precision. Many universities responded to a request to measure their QCP by stating that their databases were not designed to support such analysis. Numerous explanations were given. Some institutions do not require admissions test scores, and few require test scores of transfers from other institutions. Some institutions are unable to match students in their database to their admissions test scores. Nearly all institutions were unprepared to consider their student data from the standpoint taken by this study. Most tasks faced by these analysts require them to start with students in an entering freshman cohort and track their progress to the point that they exit the system; this study asked colleges to start at graduation, then work backwards, something many college databases were not designed to support. Hence, 41 percent of the counted students at each reporting school, on average, required some kind of assumption about their attendance or test-score eligibility. This limitation voids the ability of this study to validate the model to scientific standard.

b. Census of Officer Selection Officers (OSO)

This study, in cooperation with MCCDC and MCRC, developed and administered an 84-question census of the officers currently in the field, recruiting candidates for the PLC and OCC programs. Results from the census were applied to

verify assumptions within the model, and to identify potential propensity measures. The census obtained 41 unique responses from the population of 71 OSOs who recruit from college populations. The response was limited by spring turnover of some OSO billets and by concurrent changes within the MCRC officer recruiting structure.

Table 1 displays response rates for each recruiting district. Responses from regions in New England and the Southern U.S. (the 1st, 6th and 8th Districts) are limited to half of the assigned respondents.

Recruiting District	Number of Assigned OSOs	Number of Respondents	Response Rate
1	15	7	47%
4	12	10	83
6	10	5	50
8	10	4	40
9	12	8	67
12	12	7	58

Table 1. Response to OSO Census. (Created by Author)

c. Data Collected from Existing Databases

(1) Applicant Records. Marine Corps Recruiting Command provided records on 14,940 applicants to the PLC and OCC programs between FY1992 and FY2001. This database supported verification and development of a propensity measure. The data was maintained in the Automated Recruit Management System (ARMS) database. As the title indicates, this database exists to communicate the real-time status of a candidate's application as it works through several levels of review. Its value as a source of information about past officer program applicants is limited by varied reporting and record-keeping policies over the decade of its existence. From this database, 14,613 (97.8%) records were complete enough to support the verification, and 7,063 (47.3%) records were selected for the propensity measure, based on their relevance and completeness.

(2) Candidate Records. Officer Candidates School provided data on over 9,000 officer candidates who entered OCS during the years 1993 – 2001. Records from the years 1992 – 96 are generally limited to paper graduation rosters and

class standings. 1995 records are less complete, as OCS kept data only on those 1995 candidates whose home of record was California, due to a legal matter that drew the attention of some state officials. The data collected starting in 1997 is extensive and complete, and includes reasons for candidate failure and many demographics such as college major and physical fitness test scores. This database was used to clarify issues that arose within the ARMS data.

(3) Commissioned Officer Records. The HQMC Office of Manpower and Reserve Affairs provided accession files on 28,252 Marine officers commissioned between fiscal years 1980 – 1999. This database, named the Marine Corps Officer Commissioned Officers Accession File, was developed by the CNA. It too was used to clarify issues that arose within the ARMS data; it is complete and correct for purposes of this study.

(4) U.S. Department of Education Postsecondary Education Data. Most of the data that supports the Jareb-Parker model and the forecasting model developed by this study was obtained from the U.S. Department of Education's Integrated Postsecondary Education Data System (IPEDS). IPEDS is the mechanism through which the federal government measures the success of the United States postsecondary education system, as well as one means by which it evaluates compliance with federal regulations regarding the opportunity and treatment of minorities and college athletes. Nearly 10,000 postsecondary institutions supply information to IPEDS on an annual basis. Hence, this data is self-reported. Once submitted, the data undergoes a lengthy adjudication process before publication. The potential cost associated with inaccurate reporting to the federal government, and the adjudication process, suggest that this data is the most reliable available. It is also, however, somewhat dated. At the time of this study, the latest data available—autumn 2000 reports—was over two years old.

(5) Barron's and Other Private or Commercial Sources. An important mechanism within the Jareb-Parker model relies on data obtained from *Barron's College Admissions Guide*. This study continued use of this data, as well as data from the Carnegie Foundation, US News and World Report's *America's Best*

Colleges and the *Common Data Set*, a commercial media enterprise in which most four-year colleges participate. Such sources rely on self-reported data.

3. Assumptions

This research assumes that the Jareb-Parker model attempts to measure that quantity that MCRC desires to measure. In other words, it assumes that MCRC officials clearly communicated the attribute they wanted measured, that this desire has not changed, and that Jareb and Parker understood and designed their model to measure it.

Examination of the model's performance required several assumptions that are discussed in Chapter V of this study.

The expanded forecasting model developed by this research relies on the assumption that the U.S. Department of Education will continue to maintain publicly accessible enrollment and graduation data in a system such as IPEDS.

E. LITERATURE REVIEW AND METHODOLOGY

1. Literature Review

This study presents three bodies of literature, covering the topics of model validation, officer recruiting market and military recruiting models.

Discussions of model validation presumably extend back to the time of ancient Greece. Since the acceptance of computer simulation as a credible form of modeling, this topic has received renewed interest. Some in the military operations research community have proposed the highest of standards for warranting a model as "valid." The review of related literature discusses these standards and contrasts them to other common model validation processes and standards.

The subject of college demographics has generated an occupational field known as "institutional research" (IR). The U.S. Department of Education, every state government and nearly every U.S. postsecondary institution employ statisticians who collect, analyze and disseminate information about college students, faculty, administration and facilities. Numerous consortia and research institutes collaborate on these studies. U.S. News & World Report, Barron's and several other major media efforts purchase, reformat and market the work of those in the IR field. Some of the data

and research reports, though, are free for public use. The review of literature discusses recent findings by the IR community regarding the behavior of college students that may have influenced the past performance of the Marine officer recruiting structure.

Since the repeal of military conscription in the early 1970s, the field of military recruiting has generated a wealth of research. The vast majority of this literature studies enlisted, not officer, recruiting. This makes sense, considering that during FY99 the DoD enlisted 11 personnel for every officer it commissioned onto active duty (DMDC, 2000). The methodology employed in these studies serves as a useful guide, but the conclusions do not necessarily apply to the officer market. This enlisted-centric approach has lead to a void in data about officer program applicants and college and recent graduate populations. That research specifically focused on the commissioned officer market is generally of little value to this effort, for it is influenced by programs beyond the scope of this study, or is contracted from commercial vendors who retain proprietary interest in their work. The review of related literature discusses recent attempts to model the enlisted market, and discusses a model used by the U.S. Army to establish goals for its officer candidates school recruiting efforts.

2. Methodology

This study tests the Jareb-Parker model along three axes: the credibility of the model's methods and database; the suitability of its underlying assumptions to the problem at hand; and the agreement of its output with enhanced observations of QCP. The analysis begins with a review of the methods employed by Jareb and Parker to estimate QCP. The research checks for erroneous transcription of source information to the database that supports the model. Then, the research discusses the assumptions that underlie the model, and their concordance with the perceptions and needs expressed by surveyed MCRC personnel. Finally, the study compares the model's output, and critical coefficients, against field measurements obtained through survey of postsecondary institutions and enhanced by imputation. Statistical tests are applied to judge the significance of the difference between the predicted and observed values.

The study then develops a measure of propensity and measures of effectiveness against which to gauge the propensity metric. Regression and classification trees are used to further support the measure.

The Jareb-Parker model is then expanded by increasing the number of colleges within the database and by adding IPEDS enrollment and completions data.

The project concludes by forecasting QCP through fiscal year 2004. A forecasting method is selected based upon observed behavior of baccalaureate cohort sizes over time. Fields are created in the database to support this forecasting. User forms and a macro are programmed in Microsoft VBA to develop the forecasts and provide MCRC planners with a flexible tool with which they may examine QCP counts at user-selected times and locations.

F. DEFINITIONS AND ABBREVIATIONS

Appendix H contains a glossary of the terms used throughout this paper.

II. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

A. LITERATURE ON MODEL VALIDATION

Recorded discussions of model validation may extend to the time when ancient Greek astronomers debated models of the solar system. Models range from the simplicity of a single equation to the complexity of contemporary nuclear warfare simulations. The dialogue over validation rarely distinguishes between the simple and the complex; regardless of size or purpose, the same processes can apply.

Since the Allies introduced computer-aided modeling techniques to help guide their efforts in World War II, modeling of natural phenomena has become a prominent feature in national security and industry. The uncertainty and huge datasets introduced by computer simulation and the stakes of such issues as the Vietnam War, the Cold War and nuclear conflict seem to have driven decision makers to demand that analysts warrant the outcome of models used to guide policy in these areas. One gets the impression from model validation literature of the past four decades that this pressure often lead to premature decisions, and drove significant debate over the process and definition of validation (Arrison, 1969; Hoeber 1981; Thomas 1997). It is apparent that defense-related fields often take a stricter approach to model validation than the broader scientific community. The disagreement centers on the standard to which models should be validated.

James Arrison, an operations research student at NPS (graduating class of 1969), described the environment of model validation during the late 1960s. The client and analyst agree on the degree to which the disparity between actual and simulated output may differ. The data is gathered; one classic statistical test—paired t-test, Kolmogorov-Smirnov, binomial, Fisher or Wilcoxon—is applied to the outcome. If the difference in the results remains plausibly within bounds, the model is declared "valid." Arrison agrees with this philosophy, but suggests two shortcomings with its implementation: the concepts of cost and utility are ignored by the analyst but not by the decision maker, and the use of a single test both reduces the outcome to a pass/fail test and requires

underlying assumptions, such as the assumption of equal variances, that might not be appropriate. Arrison proposes that the validation process present the client with results from several parametric and nonparametric tests, as well as results from utility analysis, such as cost minimizations for a range of levels of significance. (Arrison, 1969)

A 1981 review of defense-related modeling efforts by Hoeber advocates a three-step validation process that is evident in many contemporary scientific reports. The first step should ascertain whether the model is the most appropriate available for the problem at hand. Next, validation should establish if the underlying assumptions and theory are sufficient for the problem. Finally, the validation should compare the model's output against observed data. Hoeber offers that, ideally, all models should be validated, but that many cannot be. Furthermore, he indicates that a client may refuse to accept insight gained by the model, regardless of the status of the model's validity. (Hoeber, 1981)

Apparently in response to controversial performance of combat simulation models during Operations Desert Shield and Desert Storm, the RAND Corporation and the Military Operations Research Society published more essays on model validation (Hodges and Dewar, 1992; Thomas, 1997). These essays offer the following discussion on "validity."

First, a model's purpose matters. This purpose will drive the method chosen to attempt validation. Models either predict outcomes, or improve understanding of a system. The two types of models require different approaches.

Hodges and Dewar define prediction as production of "a statement about an observable or potentially observable quantity or event." A predictive model has the following appropriate use:

- The model makes a statement about an observable or potentially observable quantity;
- The model's accuracy can be measured; and
- The model's accuracy, in its intended environment, has been measured.

Hence, these authors believe that analysts should not declare a model valid if it simulates a natural system whose outcomes cannot be accurately measured. The literature describes many attempts to warrant "unvalidatable" models through various

measures short of comparing model output to observed data. Hodges and Dewar firmly reject common notions that a model can be validated in this manner, i.e., on the performance of its components, on the logic of its design, or on intuition. "Validation" is to them a warranty that should only be applied after the model has met the strictest of scientific standards.

The notion of validity itself inspires debate. These authors maintain that "validity" should not be considered a binary quality, where a model either is or isn't valid. Instead, the complexities of nature and the difficulties associated with measuring reality require "validity" to be seen in "provisional" terms. A model may be found valid on its first test, and from there it can accrue additional validity with each passing inspection. Conversely, experience can cause a model to lose validity. Hence, the Hodges and Dewar concept of validity carries a degree of confidence.

This observation leads to an apparently obvious statement: a model must be validatable to be validated. Such a statement may appear elementary, but the authors have observed attempts to validate models that cannot be validated. The 1980s literature offers several examples of widely used DoD models that saw extensive validation efforts, which proved elusive for want of data. Hodges and Dewar suggest that validation of a predictive model requires four conditions of the natural system it intends to simulate. First, the system must produce output that is measurable. The outcome must also be repeatable, given identical input at a later time. The output must be unaffected by parameters not considered by the model. Finally, the system must permit "ample" collection of data. An analyst, the authors caution, should not warrant a model that fails to strictly conform to these conditions.

Hence, models can have four states: pending-validation, invalid, unvalidatable, valid. If, in the process of validation, a model is declared unvalidatable, it still may be found useful. Hodges and Dewar discuss seven appropriate uses for unvalidatable models. The authors believe a predictive model that is found invalid should be either discarded or rebuilt.

Literature from outside the operations research community tends to offer more leeway in the definition of validity: "validation" is often described as only the process of determining how accurately a model measures that quality that a client wants measured. Such definitions seek an imprecise degree of conformity with nature, and only within bounds laid down by the intended user of the model (Department of the Navy, 1999; Hand et al., 2001). Law and Kelton (2000) offer another common definition of "validation": as long as the model, with its errors, provides valuable insight into the problem at hand, it may be considered valid. With this definition, the judgment of subject matter experts and clients determines the breadth of acceptable error. Bellomo and Preziosi (1994) describe the validation of models such as the Jareb-Parker in mathematical terms. Prior to validating the model, an acceptable difference between the results of the simulation and the results of the solution must be established. Bellomo and Preziosi call it "the level of accuracy required by the model."

One finds general agreement across the research community in regard to model classification. A model may be designed to describe a system in a more understandable manner—a descriptive model. Or, a model may be designed to predict future behavior of the system—a predictive model. Either model is an imperfect representation of a natural system. It is unreasonable to expect a model's output to perfectly match the output of the natural system. A certain degree of error must be expected in any model.

Statistical approaches to model validation vary. Mathematical and scientific journals offer thousands of model validation cases. Few of these cases discuss the literature on model validation. Many simply collect observations or field measurements, then apply some sort of metric to determine how well the model's predictions conform. In some cases, this metric involves a simple visual check of the observations and predictions, plotted against each other. Some studies plot the ratio of predicted to observed values; trends in the model's predictive ability thus easily appear in the form of points straying from the value of 1. In cases where the appropriate conditions are met, some validations apply one or more classical hypothesis tests to gain a quantitative measure of the model's accuracy.

The Department of Navy (DoN), through its modeling and simulation office, has formalized its validation process under a Secretary of the Navy Instruction titled *Verification, Validation and Accreditation of Models and Simulations*, SECNAVINST 5200.40 (DoN, 1999). This instruction requires two validation "events" during a model's development. First, the DoN client approves a developer's concepts, assumptions, design intentions, and expected data usage. Then, after the model itself has been completed and verified, a second validation "event" compares the model's output against actual output from the system it represents. Validation is thus viewed as a single finding that leads to formal accreditation of the model. The instruction offers an approach to models that, in the above-mentioned operations research literature, would be considered unvalidatable. It allows the results of models to be validated against someone's concept of the expected behavior of a system. Hodges and Dewar reject this notion of validating against a sort of peer or subject-matter-expert review. As for models that are found invalid by DoN efforts, the instruction seems to indicate that accreditation would be postponed and the model returned to the developer for modification. This study infers that the instruction accepts the concept of validity accrual. The instruction permits the accreditation authority to order additional validation tests, and the DoN order also permits the authority to use the historical performance of both new and legacy models as a basis for the accreditation decision.

B. LITERATURE ON THE OFFICER RECRUITING MARKET

1. General

The officer recruiting market may be defined as the population of 18 – 28 year old male and female college students and recent graduates, who are physically fit and of above average intellect, as measured by a standardized test such as the SAT. Students, to be considered within the market, must be enrolled full-time. There is a wealth of research into college demographics, and some of this research describes this market. This literature suggests that over the past decade, several trends have emerged in the U.S. college population that have altered the size and density of the population qualified for, and interested in, a Marine officer commission.

2. Size of the Market

The size of the U.S. college population has increased during the past twenty years. College enrollment rates rose among young adults from 40 to 65 percent during the period 1979 – 1995. The U.S. Department of Education found that this growth stabilized, however, between 1993 and 1998. During the fall of 1999, 15.2 million Americans enrolled in some form of postsecondary education. The sector considered by the Jareb-Parker model counted an enrollment of 3.05 million: men, enrolled full-time, in 4-year, degree-granting institutions. The increases over this decade in the overall college population came mainly from younger, female and Hispanic sectors of the U.S. population. (Asch, Kilburn and Klerman, 1999; NCES, 2002)

The college subpopulations from which the Marine Corps recruits most of its officers, though, may not have experienced this same historically significant rate of growth. In fact, Figure 1 shows that male full-time enrollment in the 18 – 21 age group actually declined by 90,000 students during the years 1990 – 1997. Enrollment for this group then began to rise in 1998, and is projected to rise through 2010, though not at the pace at which female enrollments will rise. This rise since 1997 caused the number of bachelor's degrees conferred on men 1998 – 2000 to rise 8 percent, while the number of bachelor's degrees conferred upon women in the same period rose 18 percent. (NCES, 2002)

Related literature also reveals some interesting population trends by field of study. Consider the recent distribution of fields among applicants—both male and female—to OCC and the PLC programs in FY01 displayed in Figure 2. Over 55 percent of applications to these two programs came from students in the fields of "social sciences and history," "business" and "foreign languages and literature." Another nine percent of applicants came from the engineering field, while four percent came from the life sciences. This group of applicants differs from the surrounding college population in its heavy influence from the social sciences, foreign languages and engineering, and its lack of participation from the education, health and arts fields.

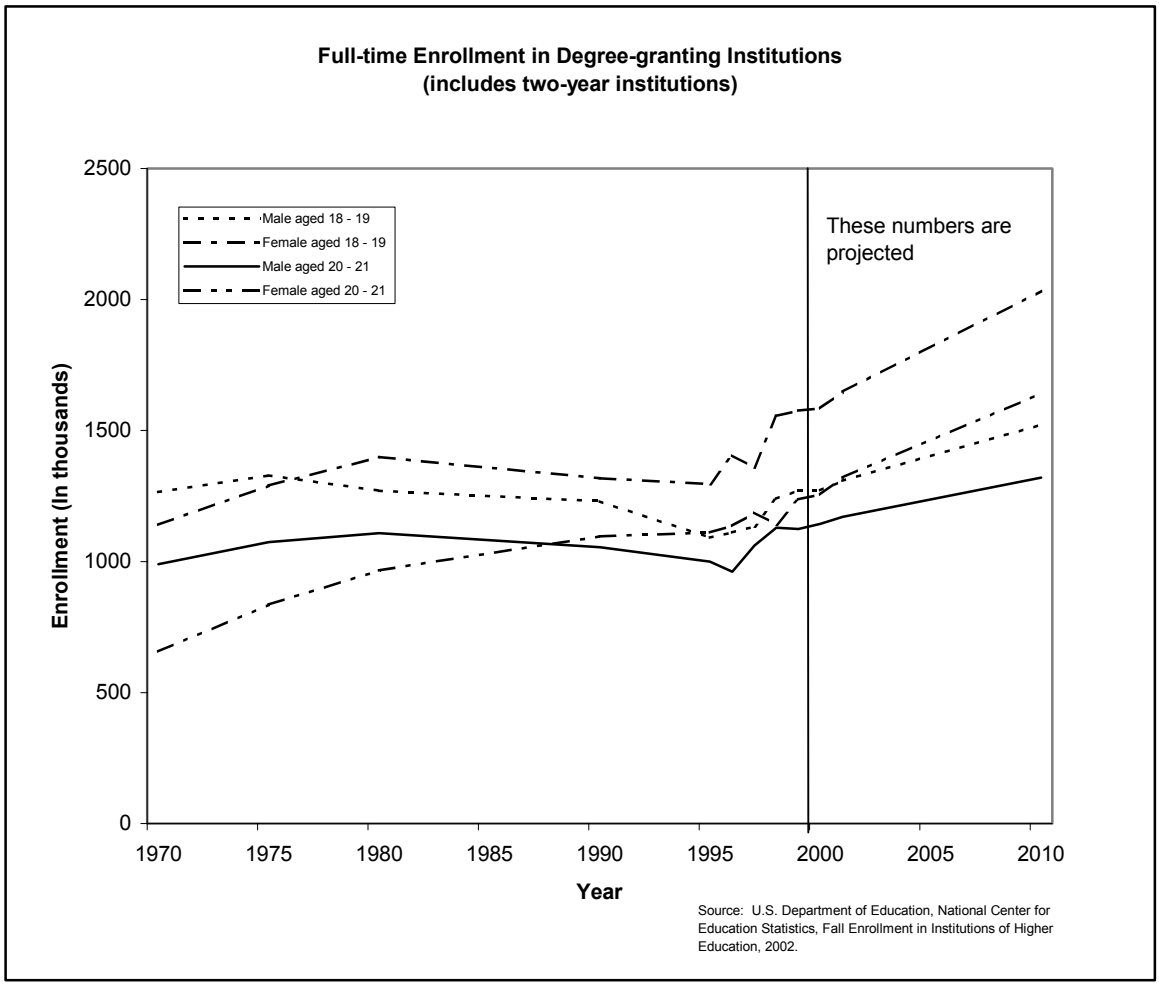

Figure 1. United States Full-Time Enrollment in Postsecondary Education. (From: NCES, 2002)

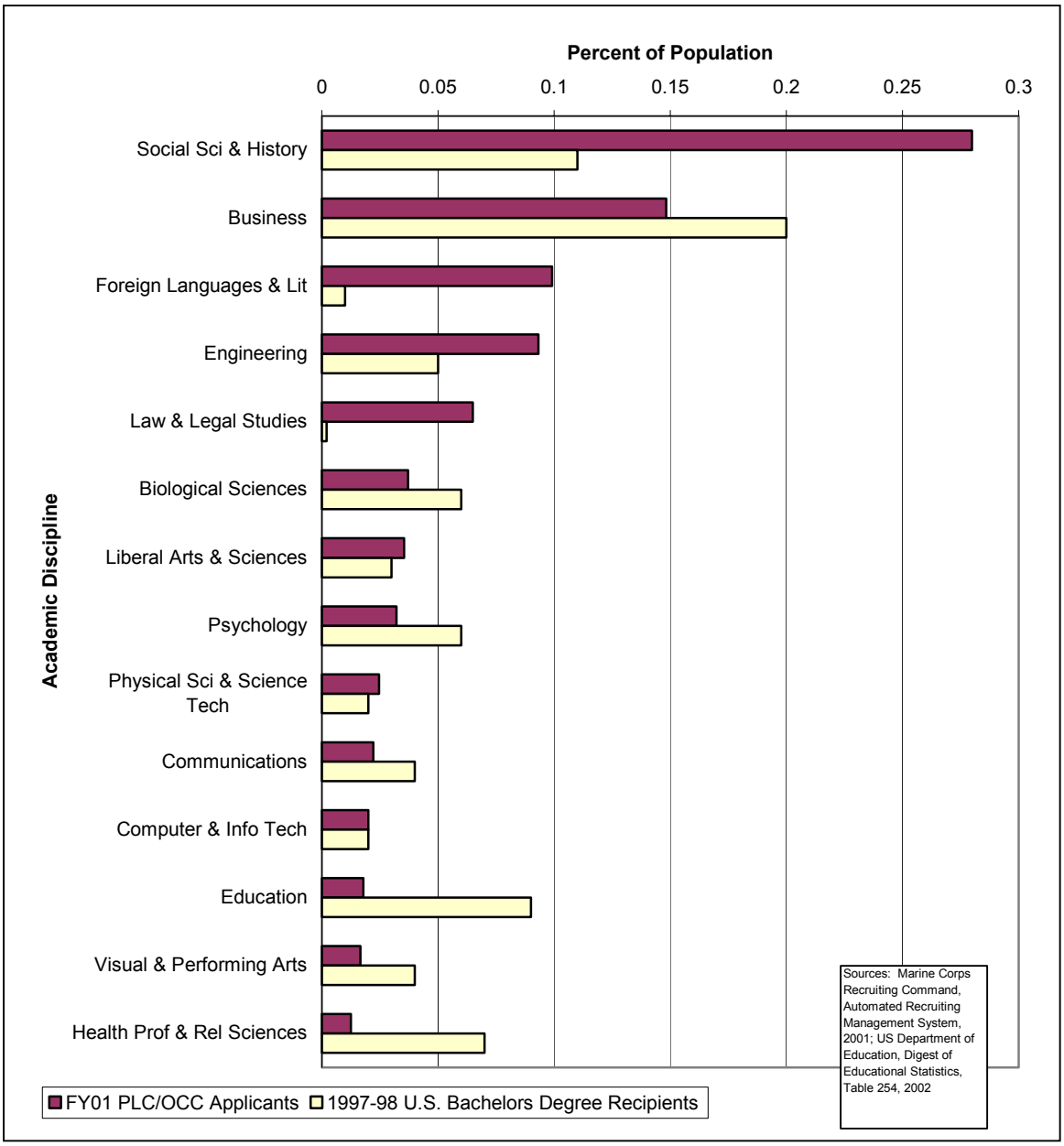

Figure 2. Comparison of FY01 PLC & OCC Applicants to the 97-98 U.S. Baccalaureate Cohort (both sexes), by Academic Discipline. (Created by Author)

During the past decade, these academic fields from which the Marine Corps draws a majority of its OCC and PLC applicants generally contracted. Figure 3 plots the levels for 30 years of male undergraduate participation in the five fields from which the Marine Corps draws most of its officers. Successful male participation in undergraduate social sciences and engineering fields declined steadily through the last decade. Business

degrees declined, and then rose sharply, while life sciences degrees rose, and then declined. Foreign languages and literature oscillated around the 3,600 degrees per year mark. Of the five fields, only life sciences posted a significant overall gain over the ten-year period. The total number of male undergraduates who participated in these fields declined 3.3 percent over the final decade (NCES, 2002), suggesting that the officer recruiting market may have contracted despite an overall increase in U.S. college participation.

College student demographics changed in another manner that affects Marine officer recruiting: students are consolidating on larger campuses. The U.S. Department of Education reports that the growth in college participation has affected a relatively small number of schools. Half of the U.S. college population is now concentrated in the largest 10 percent of campuses (those with 10,000 or more students). Forty percent of schools enroll fewer than 1,000 students, and in total these small schools account for only 4 percent of the U.S. college population (NCES, 2002). Such a trend could favor the small OSO force, provided the recruiters are located near the growing campuses.

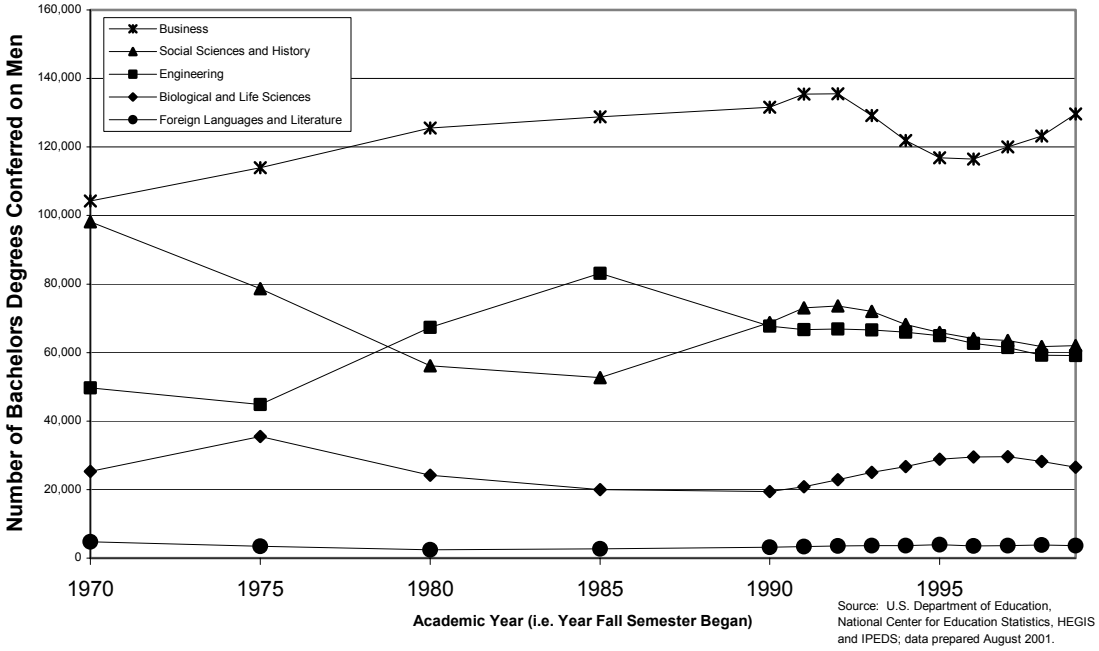

Figure 3. Comparison of Production by Most Popular OCC/PLC Applicant Academic Fields, 1970 - 1999. (Created by Author)

3. Persistence within the Market

Studies of student behavior often consider the quality of those who maintain uninterrupted enrollment in a four-year institution until they earn a bachelor's degree. This feature is known as "persistence." Persistence is an important trait to recruiters for the PLC program. The MCRC instruction on officer recruiting states that four-year completion is to be "the norm" among participants in the PLC program. Students who fail to remain enrolled full-time disqualify themselves from the program (HQMC, 1989). Both the Marine Corps and the U.S. Department of Education define "full-time" as enrollment in at least 12 credit hours (MCRC, 2001; NCES, 2000).

Literature on college demographics suggests that this expectation of four-year enrollment reduces the size of the officer market, because most undergraduates take longer to earn a bachelor's degree. The Consortium for Student Retention Data Exchange (CSRDE), after reviewing retention data from over 300 four-year degree-awarding institutions, found that perhaps only one third of freshmen who entered college during 1993-94 achieved a bachelor's degree in four years (CSRDE, 1999). Less than half earned a degree even in five years. An oft-cited study by UCLA researchers Dey and Astin observed that while one-half of 1966 freshmen obtained their degrees in four years, only one-third of the 1982 class were able to accomplish the same. They concluded that only two in five students completes their bachelor's degree requirements in four years (HERI, 1996). A U.S. Department of Education longitudinal study found that 39 percent of students who enrolled in four-year postsecondary institutions during the 1989-90 school year never achieved a degree; only 31 percent achieved the degree after four years (BPS: 90/94). Hence, the Marine Corps requirement for persistent students may mean that as few as three of every ten students seen by recruiters meet the attendance-eligibility standard.

This recent trend of increasing time-to-graduation has probably made recruiting more difficult. The trend is widespread and serious enough that it has generated numerous research activities and legislative efforts. Several states have recently linked institutional support to reduced times-to-degree.

The literature cites several causes for this trend. Federal aid and accreditation requirements usually require postsecondary institutions to survey graduates. These surveys often ask about time-to-degree. Students frequently blame their extended time-to-degree on unavailability of required courses or on an individual decision to change majors. Adelman (1998) observed that 16 percent of students during the 1980s enrolled without a major field of study in mind, and of the remainder, 68 percent changed their major. Ethnic background and sex consistently appear as a significant factors in years-to-graduation. Several other studies, though, find that high school counselors and societal pressures drive into college many students whose aptitudes and interests better suit them for vocational training (U.S. Department of Education, 1999). This trend of delayed graduation may indicate that much of the increase in college population comes from students not considered desirable by PLC/OCC standards.

Surveys and other longitudinal studies are a common technique for measuring qualities such as persistence among college students. A recent multivariate analysis of student characteristics and their relation to time-to-degree concluded that the students responsible for this adverse trend in time-to-degree simply lack motivation to complete college in four years. The study recommended that more desirable student outcomes could be achieved by raising the current U.S. Department of Education definition of "full-time" enrollment from 12 to 16 semester credit hours. (Bowling Green, 2000).

Along those same lines, CSRDE and Astin both found that graduation rates were a function of institution control (public or private), selectivity, race and sex. CSRDE tracked the survival of the 1994 first-time freshman cohort. After four years of college, students at private colleges graduated at nearly twice the rate of public school students (45 percent compared with 27 percent). After six years of college, 66 percent of students at the most selective (mean SAT(C) score > 1,100) schools graduated, compared with the least selective (mean SAT(C) score > 990) schools' rate of 33 percent. At any level of selectivity, Whites and Asian-Americans graduated at rates nearly double that of the other races (Within six years of school, about 60 percent of Asian-Americans and Whites completed, compared with 35 – 42 percent of students in other races) (CSRDE, 2001). The final completion rate of women exceeded that of men, 61 to 56 percent. Astin (1996)

studied the outcome of 75,000 college entrants between the years 1985-94 and found that women were more likely than men to earn their bachelor's degree: after four years of school, 43 percent of women earned a degree, compared with only 37 percent of the men. Astin found that Asian-American and White four-year graduation rates of 50 and 43 percent consistently exceeded that of other race groups, whose rates were at or below 30 percent. Lee (2001) repeated many of these findings with a multivariate analysis of data collected on students through a survey.

The rigor of high school preparation, though, may be the strongest predictor of persistence. The aforementioned 1989 – 1994 U.S. Department of Education longitudinal study (BPS: 90/94) found rates of failure among college students of the 1990s to be similar to those found by CSRDE. The study suggests that the rigor of one's high school education is a better predictor of graduation than either freshman year performance or performance on standardized test scores. This study showed that the more rigorous a high school curriculum, the greater the probability that a student would demonstrate persistence through college. This study also felt that a rigorous high school curriculum helped overcome socio-economic disadvantages. Clifford Adelman, senior research analyst at the U.S. Department of Education, repeated these results (1998). He compared thousands of high school transcripts to the behavior of students over two eleven-year longitudinal studies. He found that bachelor's degree completion rates correlate most solidly to the highest level of mathematics studied by a student in secondary school, for any college academic discipline, meaning that students who took the most difficult math courses in high school were most likely to complete their bachelor's degree requirements. This correlation strengthens for students from lower socio-economic backgrounds. These findings suggest that officer recruiting may benefit from increased marketing to college-bound high school students in the more challenging schools.

4. Market Forecast

The officer recruiting market is expected to expand through the next decade. The size of the 17 to 21 year old population is projected to increase through 2010, and to become ethnically more Hispanic (Defense Science Board, 2000; RAND, 2001). A recent study by the U.S. Department of Education projects college enrollments to rise 17

to 24 percent, and the number of conferred bachelor's degrees to rise 13 percent, from 1998 to 2010. The study predicts the college population in 2010 will be only slightly more female, from 57 to 58 percent. College age groups are also expected to shift. In 1998, 18 to 24 year olds comprised 57 percent of college enrollments; the study forecasts this share to increase 3 percent by 2010 (Gerald and Hussar, 2001).

The U.S. Department of Education uses linear regression to produce ten-year forecasts of the number of bachelor's degrees conferred. This model bases its prediction on three factors: a recent number of bachelor's degrees awarded; Census Bureau projection of the 18-24 year old population; and undergraduate enrollment in four-year postsecondary institutions. The model projects degrees conferred for both sexes, under three different economic conditions. The model has proven accurate. Analysis of thirteen iterations of these forecasts returned a mean absolute percentage error of only 3.1 percent for two years out, and a 6.5 percent error for five years out (NCES, 1999).

Robert Senter, a 1990 NPS graduate, described U.S. Navy models used to forecast supply of potential commissioned officers. A nuclear propulsion officer model applied multiple regression to time-series data on such variables as money spent on advertising, military-to-civilian pay ratio and area unemployment rate. Senter interviewed Navy analysts who found its results inconsistent, due to an insufficient number of observed time periods, possibly inaccurate observations, poor assumptions and conditions not accounted for by the model. A more successful medical officer goaling model applied weights to historical attainment figures, and measures of recruiter effectiveness and competition from other sectors. Other models in use by the Navy were found inadequate because they failed to account for propensity, contained subjective weighting factors, or relied on outdated data. (Senter, 1990)

This aforementioned literature thus supports the inclusion of propensity in officer recruiting models, and supports the manner of forecasting employed by this research.

5. Competitive Pressures on the Market

The competition for college graduates intensified during the 1990s (Asch, Klerman and Kilburn, 1999; Defense Science Board, 2000). One aggregate measure of the competition for college graduates is known as the "college premium." This premium

is defined as the difference between the average real wage of a four-year college graduate and a high school graduate. Asch, Klerman and Kilburn found that the college premium rose 40 percent between 1979 and 1995, leading them to conclude that competition for high-quality youth (The DoD defines "high-quality" as having earned a high school diploma and scored in the 50th percentile or above on the Armed Forces Qualification Test (AFQT). (DMDC, 2000)) had intensified. They also suggest that this increase in competition for college graduates reflects a permanent change to the U.S. labor market, in that the labor market, more than at any other time in this nation's history, requires college-educated employees.

Because a larger percentage of high-quality youth is now drawn to college, Asch, Klerman and Kilburn believe that enlisted recruiting efforts for high-quality youth now compete more with postsecondary institutions then with the unskilled labor market. The Defense Science Board (2000) concurs. Kilburn and Klerman (1999) conclude in a related study that men not of high quality are not as attracted to the rise in the college premium, preferring instead to chose between work or enlistment. Meanwhile, both the Defense Science Board (2000) and Murray and McDonald (1999) found that during the 1990s, increases in recruiting resources brought less benefit (in terms of quantity of high-quality contracts produced) than in previous decades, suggesting a higher interest in college among high-quality youth. This trend leads the authors, and the Defense Science Board, to recommend that DoD focus more of its enlisted recruiting efforts on college dropouts, junior college students and even on college-bound high school youth.

The U.S. Army intends to follow the aforementioned suggestions. The service, for many years, has maintained a presence on dozens of U.S. colleges through its ROTC units. A majority of its officers are commissioned through participation in these units. Its enlisted recruiting battalions have also maintained a small presence on U.S. colleges, recruiting college students for a program the Army calls "Enlisted-to-OCS." This program is similar to the Marine Corps PLC (Combined) program. College students make a commitment to serve in the Army. After earning a bachelor's degree, the graduate enters boot camp as a private. Should the college graduate succeed through boot camp, he or she is offered an opportunity to proceed directly to officer candidates

school. During FY 1998, the service sought to commission only 50 college students through its enlisted-to-OCS track. This goal is expected to increase 14-fold in two years' time. The Army anticipates recruiting 700 students into its enlisted-to-OCS program during FY 2003. (Gillen, 2001; Howell, 2001)

Hence, the literature reviewed by this study suggests that not only have OSOs faced a smaller market over recent years, they faced increasing competition from the private sector and may soon face more vigorous competition from U.S. Army recruiters.

6. Migration in the Market

Any attempt to validate a college population model is complicated by a rising trend in college student migration. Adelman (2001) refers to the 1990s as "the era of multi-institutional attendance." His study of engineering student transcripts suggests that one of every six bachelor's degrees is now awarded to a transfer student. Migration complicates any effort to measure actual graduation rates, because few if any schools record the time spent by an incoming transfer student in other schools. It also makes it impossible for most schools to measure the performance of all their students against standardized test performance in high school, because few, if any, schools record the SAT or ACT score of a student who transfers in from another institution. Transfer students are valued more on their college academic performance than on test scores earned as a junior or senior in high school. Longitudinal studies or surveys are the only method to measure the true persistence and intellect of these migrating students.

Officer recruiting efforts that ignore migrating students may miss a large number of qualified people. Adelman (1998) concluded that migration stems more from uncertainty about major choice than from sloth or academic difficulty. Adelman also found that students who enter four-year institutions from community colleges attain their bachelor's degrees at rates equivalent to those of students who enter four-year institutions from high school. A recruiting model, to be successful, must somehow account for migration.

C. LITERATURE ON MILITARY RECRUITING MODELS

1. Market Models

Many recent models of the enlisted recruiting market are based on macro-economic data and familiar geographic delineations, such as U.S. Postal ZIP code. The nature of enlisted recruiting facilitates this approach: few high school students travel beyond their neighborhood to attend school, and few sectors of the unskilled labor force have reason and means to migrate to other areas of the country. Murray and McDonald (1999), for instance, modeled the enlisted recruiting market with monthly observations of macro-economic factors within each of the U.S. Census Bureau's Public Use Microdata Areas (PUMA). The PUMA delineation program clusters counties within the United States into nearly 1,000 geographic entities. Its clustering rules produce geographic entities that both are delineated along traditional county, zip code or voting district lines and have populations of at least 100,000. Murray and McDonald obtained PUMA-level macro-economic information from a variety of sources, including DMDC, CNA and the U.S. Bureau of Labor Statistics.

Orvis and Asch (2001), on the other hand, developed a simple model of the enlisted recruiting market on a national scale. Their study derived an expected enlistment rate from responses to the annual DoD Youth Attitudinal Tracking Survey (YATS), and then multiplied it by the size of the male youth population.

The U.S. Army has dedicated significant resources to modeling the recruiting market. The United States Army Recruiting Command (USAREC) is responsible for recruitment of the Army's enlisted force, but also for recruitment of a small group of specialized officers, such as musicians, warrant officer aircrew, and for recruitment of college students into the Enlisted-to-OCS program. The staff at USAREC developed its own model, and named it the Army Recruiter Allocation and Mission Model (McCurry, Gillen, 2002). This model is implemented by a neural network. Its input nodes consist of six ZIP Code level observations. A hidden layer weighs these inputs, producing a proposed recruiting goal to assign to whichever recruiting brigade is assigned territory within the input ZIP Code. The inputs include both measures of past performance and

projections of future demographic growth. Table 2 lists the input and weights assigned by the neural network.

The model allows USAREC planners to adjust monthly recruiting goals based on the market on which the Army wants to focus its recruiting efforts. The model considers the number of high school graduates and high school students in a given area. It further attempts to classify the population by intellect, which the model refers to as "mental level." "Alpha" designates a desirable, high-quality youth. USAREC obtains many of these population estimates from a joint service database maintained by DMDC. The density of the population in any given ZIP code, by intellectual category, is derived from AFQT results administered annually at high schools across the country.

US ARMY RECRUITING COMMAND RECRUITER ALLOCATION AND MISSION MODEL			
Input (ZIP code level observations)	**Source of Input**	**Weight**	**Remarks**
Projected 17-21 year old "Qualified Military Available"	Woods & Poole Economics, Inc.	0.2203	USAREC may replace with 2000 Census data
DoD graduate and senior "Alpha" mental level production	DoD "Marketshare" databank	0.3255	36-month rolling average of quality production by all services
Army share of DoD graduate "Alpha" production	DoD "Marketshare" databank	0.1835	# of quality Army contracts over # of quality DOD contracts
Estimate of potential contracts	Recruiting battalions	0.1208	# of households per 1,000 people over past production cycle
Freshman & sophomore college population	Recruiting battalions	0.0326	none
DoD graduate and senior lower mental level production	DoD "Marketshare" databank	0.1173	36-month rolling average of non-high quality production by all services

Table 2. U.S. Army Recruiter Allocation Model Input Nodes. (Created by Author)

Subordinate recruiting battalions also have a role in providing input to the database. USAREC staff officers produce pivot tables from the database. The model itself operates in a spreadsheet, taking input from the pivot tables. USAREC staff state that the model has performed satisfactorily for three years, though it suffers from an inability to account for propensity (McCurry, 2002). The brigade in the "least-propensed" region historically has difficulty meeting the model's mission assignment, whereas production by the brigade in the "most-propensed" region routinely exceeds the mission suggested by the model, even though the model accounts for past performance.

2. Propensity Models

This research found only one study specifically addressing the propensity of college students to serve in the United States Marine Corps. During 1970, a team of Naval War College students sought to determine if propensity was strong enough to support an all-recruited officer corps (Nichols, et al, 1970). The authors likewise found little available research on the attitudes of college youth towards military service, so they developed and administered their own opinion survey of ROTC students, officer candidates and college faculty. Their findings included a significant geographic factor: 45 percent of respondents from the Southeast demonstrated "volunteerism" versus only 31 percent of Northeasterners. Academic achievement and father's income proved inversely proportional to a stated willingness to seek a commission in the absence of conscription. Forty percent of officer candidates were drawn from just two academic disciplines: engineering and business administration. The sons of fathers with military service displayed the highest level of propensity. The authors concluded that the armed forces could not survive a repeal of conscription without a change in college attitudes and an increase in officers' benefits.

Senter (1990) discussed the inclusion of propensity measures in U.S. Navy officer goaling models. These measures attempt to address perceived regional differences in the willingness of medical and engineering officers to enter the Navy. After studying YATS responses, he concluded that YATS measures of propensity could not be applied to officer market models because YATS excludes dormitory residents. Senter then reviewed the Navy Recruiting Command (NRC) practice of using Barron's or Gourman's

measures of college "quality" as measures of propensity. Higher quality schools tend to charge higher tuitions. The practice assumes that students with more money invested in their education are less likely to enter a relatively low-paying career in the military. Senter disagreed with this assumption, but found no quantitative study to support either argument. He then attempted to apply regional measures of earnings and employment to account for propensity. The universally low unemployment of engineers and medical professionals caused him to discard the employment measure. NRC, however, applied regional disparities in engineer and medical income to account for propensity in its models.

A study of student behavior at schools of different quality suggests that programs such as PLC should be attractive to students in more expensive schools. Table 3 shows the findings of Lee (2000) from the 1995-96 academic year. The data suggests that cost is associated with selectiveness of admissions. One might conclude from this table that undergraduates at the more expensive institutions are more likely to:

- meet PLC/OCC qualification;
- pay for school with loans or work-study rather than working outside school;
- be concerned with an organization's image; and
- be more willing to leave home to associate with an institution with a famous reputation.

The remaining military propensity models reviewed by this survey attempt to measure the predisposition of high-school aged youth to enter the armed forces under an enlisted contract. The commercial sector offers some services that measure attitudes among college students towards military service. Notable is the UCLA Cooperative Institute Research Project (CIRP), a decades-long project funded in part by the American Council on Education. This program surveys thousands of incoming freshmen each year on such topics as their values, their occupational hopes, and the occupations, incomes and values of their parents. CIRP specifically asks several military-related questions. The military aspects of these projects draw little attention, though, and few relevant results have been made available.

	Percent of Students Meeting Condition		
Condition Favorable to Officer Recruiter	Tuition >= $12,000, any classification of university	Tuition < $12,000, public research university	Tuition < $12,000, not a public research university
SAT Score >= 1,000	67.0	59.5	26.5
GPA >= 2.0	90.8	82.4	75.2
Humanities & Business Majors	60.1	47.9	51.8
Received Work-Study	32.9	6.5	11.4
Received Loan	58.2	41.6	45.7
Worked at least 15 hours per week while enrolled	22.3	35.3	46.7
Attended because of school reputation	50.4	41.1	28.4
Attended because close to home	17.4	30.8	36.3

Table 3. Comparison of 1995-96 Undergraduate Student Achievements and Values, by Tuition Cost. (Created by Author)

Some models measure propensity with individual data, such as test scores, race, mother's education and stated expectations. Hosek, Peterson and Eden (1986) combined data from two surveys of high school youth and recent graduates—a 1979 DoD Survey of Personnel Entering the Armed Forces, and the 1979 wave of the National Longitudinal Survey of Labor Force Behavior, Youth Survey. Using logit regression, they suggested that the enlistment decision could be explained by a complex interaction of personal characteristics and stated expectation for more education after high school. Family income, for instance, showed little effect on the decision to pursue a bachelor's degree, though it did influence the choice of which school to attend. The behavior of students differed from the behavior of graduates, a finding that may reflect in the behavior of PLC versus OCC applicants. Kilburn and Klerman (1999), meanwhile, revised earlier individual-level models of propensity with data gathered by 1992 and 1994 National Educational Longitudinal Study (NELS) surveys. Their model considered only male high school seniors and 20-year-old male high school graduates not enrolled in college, for the comparatively small number of female enlistments is resistant to inference. They concluded that individual propensity indicators generally remained consistent during 1980 to 1994, but then expanded the traditional binary (enlist or don't enlist) model to a

three-choice model: enlist, enroll or work. The Defense Science Board (2000), Orvis, Sastry and McDonald (1996), and Orvis and Asch (2001) used YATS survey results to measure propensity, all concluding that there was a decade-long decline in 16 to 21 year olds likely to serve.

Many sources consider YATS to be the best indicator of propensity to enlist. Several studies have found a strong, statistically significant relationship between YATS predictions and actual behavior of YATS respondents. Most recently, Orvis and Asch (2001) matched FY85 – 94 YATS responses with Military Entrance and Processing Command (MEPCOM) records of enlisted accessions. They found 20,200 matches. Analysis revealed that about half of youth with the strongest indicator of propensity explored enlistment options, and about one-third actually enlisted. Among those with negative propensity, only five percent actually enlisted. They found little difference between the behavior of male and female respondents.

Many models measure propensity in an aggregate sense. Murray and McDonald (1999) developed an econometric model to forecast the number of high-quality non-prior service contracts in a given month in a geographic area. Their model used two groups of variables, one group representing youth opportunities and one group measuring recruiting efforts. These variables were aggregate quantities, such as local population, local unemployment rate and local recruiter density. The Defense Science Board (2000) concluded that the same two groups of variables have been the primary factors in both enlisted and officer recruiting success since 1973.

Thus, recruiter density, or recruiter access, has often been used in military propensity models. Orvis, Sastry and McDonald (1996) and Orvis and Asch (2001) demonstrate that enlisted recruiter access to high school students remained steady between 1991 and 1996, but contacts with high school students dropped, possibly due to an interaction with force reductions and more efforts to recruit high school graduates. The overall lesson taken from the review of literature on propensity models suggests that though the benefit gained by propensity measures or recruiter contact in models has not been studied (with the exception of propensity measures based on YATS), the absence of these factors has often been cited as a probable cause of model inadequacy.

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III. ROLE OF THE MODEL IN OFFICER RECRUITING

A. GENERAL

This research supports Marine Corps efforts to improve recruitment of candidates for OCS. Of the three primary sources of USMC officer commissions (the United States Naval Academy, the Naval ROTC and OCS), OCS provides the highest percentage of commissions. OCS candidates are recruited from the population of college students and recent college graduates in the United States and its Territories, as well as from the enlisted force, both active and reserve.

The Marine Corps uses five programs to funnel candidates into OCS. The most important program is PLC, which offers a sort of summer internship program to college freshmen, sophomores and juniors. This program attracts many students deterred by the service obligation, uniform and study requirements of ROTC and the service academies. MCRC values this program because its participants return to college, where they frequently attract other qualified students. The program's structure also facilitates projection of OCS class size and recruiting requirements.

Prior to fiscal year 2001, MCRC relied on a "naïve" model when distributing its officer recruiting goals. MCRC receives its annual officer-recruiting goal from Headquarters, Marine Corps. This goal was—and remains—partitioned by sex, and by race. The Marine Corps classifies the race of its population into four sets: White/Caucasian, Black/African-American, Hispanic, and Other. Despite differences in the geographic densities of these population groups across the United States, subordinate recruiting entities tended to receive an equal share of the national recruiting goal. (MCRC, 2001)

This approach to recruiting goals once met the needs of the Marine Corps. The depth of any college population readily absorbed the small numbers of officer candidates sought by the Marine Corps. Many universities draw a diverse group of students. Each district had enough such universities to provide diverse markets. The process, though, was expensive. Marine officer recruiters were signing contracts with about five college

students/recent graduates for every two that survived the screening process and ultimately accepted a commission. (MCRC, 2001)

This process encountered difficulties during the 1990s. The Marine Corps began to have problems meeting officer-recruiting goals, and began to experience problems retaining experienced officer recruiters. Participation in the PLC program declined. The cause of these trends was unclear to Marine Corps officials. A changed national security environment, a booming economy, and a different generation of youth all offered potential explanations. Officials wondered if the geographic densities of these potential officer candidates had not shifted as well. So, MCRC contracted the CNA to conduct a "quick look" study of the officer recruiting structure.

To support the study, Jareb and Parker of the CNA developed their model of the market. MCRC applied the model to its FY02 recruiting plan. Each recruiting district received a share of the national goal based on Jareb and Parker's college-level forecasts. (MCRC Operation Plan 1-01, 01 October 2001)

Concurrently, MCRC requested that the Studies and Analysis Division of Marine Corps Combat Development Command (MCCDC) validate the Jareb-Parker methodology and expand it. MCRC seeks expansion of the model in two areas. First, MCRC wants the model expanded to include enrollment figures by college student level. The model currently forecasts numbers of graduating seniors only. MCRC also requested inclusion of a propensity measure (*Statement of Work for the Officer Recruiting Structure II*, 2001). Jareb and Parker considered propensity for their model but stated that an unbiased propensity measure could not be established in the constraints of a 90-day study and the data available to them (Jareb and Parker, 2000).

The propensity measure offers a unique challenge. College populations may be largely ignorant of the opportunity offered by Marine OCS (MCRC, 2001). The volume of related literature and supporting data is sparse. This project was able to acquire only four other studies focused on the task of recruiting officer candidates: a forerunner to Jareb and Parker's study, published in 1993; a study focused on the Navy nurse corps; a

study focused on the Navy nuclear engineer program; and a 1970 survey conducted by Navy War College students to evaluate the feasibility of an all-volunteer officer corps.

Meanwhile, the rest of DoD and university research into the decision to join the military over the past twenty years focused on enlistment. The discrepancy between the research efforts for officer and enlisted recruiting results from the disparate sizes of officer and enlisted accession requirements. During FY99, the Marine Corps commissioned only 1,446 of 14 million age-eligible U.S. college graduates. That officer accession goal comprised just 4 percent of MCRC's entire recruiting goal for FY99 (33,000 enlisted, 1,450 officers) (DMDC, 2000). And of these 1,446 newly commissioned officers, only 916 were actually contracted by MCRC OSOs to earn a commission through OCS; the rest were midshipmen, direct commissions or recruits from the enlisted force. Yet this effort to procure 916 college graduates required the full-time effort of nearly 230 DoD personnel: 87 Marine officers (73 OSO and 14 district and national headquarters staff), nearly 70 Marine staff noncommissioned officers and around 70 civilian employees of the officer recruiting offices. When one considers the Marine Corps' investment in OCS personnel and facilities, along with the number of USMC personnel who work on both enlisted and officer accessions, efforts to improve understanding of the officer recruiting market may provide a significant return. (MCRC, 2001)

B. PLC AND OCC COMMISSIONING PROGRAMS

1. Program Academic Eligibility

The OCC and PLC programs are designed to offer potential candidates a wide range of options covering any year of college. The PLC program offers four distinct paths to a commission that are marketed to nearly every level of undergraduate and law student. Figure 4 overlays the eligibility periods of these paths with a notional four-year undergraduate enrollment and a three-year law degree program. The figure also displays the OCC period of eligibility. The PLC program is open to those applicants who are enrolled full-time in a regionally accredited college, have completed at least one academic term, and have earned at least a 2.0 grade point average. Those accepted during their freshmen and sophomore year attend two six-week summer courses at OCS,

known respectively as the Junior and Senior course. Graduates of the PLC Senior course are offered a commission upon receipt of a bachelor's degree. Undergraduates who apply after sophomore year attend a single ten-week course (the Combined Course) that is identical to the course attended by OCC candidates. Undergraduates and beginning law students may apply to a law component of the PLC program. After successful completion OCS and undergraduate studies, the PLC Law candidate receives an inactive commission. Upon admission to the practice of law, the student's commission is activated. The OCC program accepts college seniors and graduates, provided they can be commissioned before their 28th birthday. Law students and lawyers may also seek commissions in a law component of the OCC program. The age limit may be waived for either program. (HQMC, 1989)

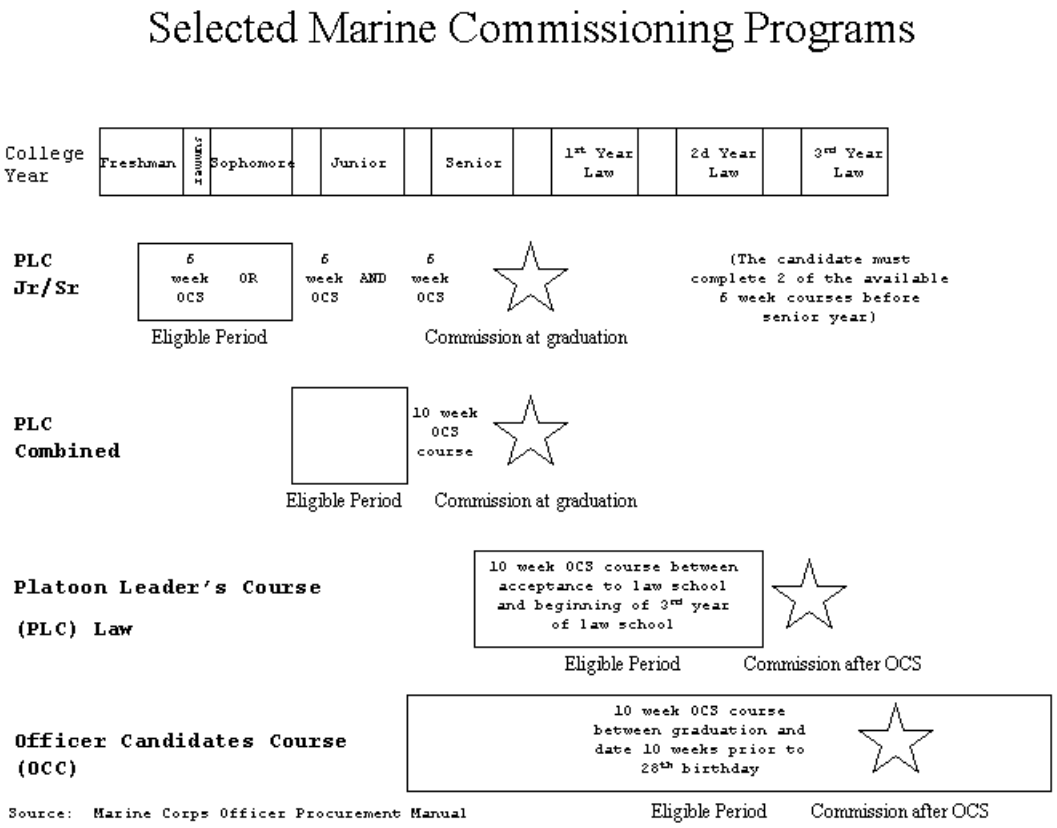


Figure 4. Eligibility Periods for the PLC and OCC Programs. (Created by Author)

In addition to this eligibility based on attendance, PLC and OCC applicants must also meet a nonwaiverable measure of intellect. While in high school, an applicant must

have scored at least 1,000 on the composite SAT or at least 45 on the summed math and English portions of the ACT. Applicants without a standardized college entrance exam score—and applicants who did not meet the threshold—take the Armed Forces Vocational Aptitude Battery (ASVAB) during the application process. They must score 115 on the Electronics (EL) portion of the exam. Applicants to any law component meet this requirement with an LSAT score of at least 150.

Between successful completion of an OCS course and commissioning, PLC program members are known as "once-trained candidates" or, informally, "poolies." To meet the contractual obligations that come with participation in the program, the "poolies" maintain contact with the local OSO while they attend school. The OSO ensures that the "poolie" remains enrolled full-time and maintains a 2.0 GPA. While in this pool, some candidates quit the program. OSOs put significant effort into minimizing this attrition. These OSOs have three reasons to curtail attrition from their pools: MCRC expects less than 15 percent annual pool attrition (MCRC, 2001); OSOs may also use "poolies" to help draw other applicants to the program; and, "poolies" who quit must be replaced, usually by increased OCC Program recruiting goals.

2. Categories of Recruiting Goals

Officer recruiters receive annual recruiting goals in three categories: by component, by race and by expected year of commissioning. Each of the two programs offers four components: ground, pilot, naval flight officer (NFO) and law. The components vary in terms of physical, age and test-score eligibility. Officer recruiters are usually tasked with finding candidates for each component of both PLC and OCC. Officer recruiters must also meet goals based on race of the applicant. The Marine Corps calls this goal a "diversity" goal. There are three sets of diversity goals: African-American, Hispanic and "Other."

MCRC does not establish separate components for female applicants. Rather, MCRC specifies that a percentage of total applications must originate from women.

3. Officer Recruiting Structure

The officer recruiting structure allocates these goals in a flexible and decentralized manner. Planners at Headquarters, Marine Corps determine annual fiscal-

year recruiting goals for each combination of component and race. Once approved, the national goals and required female percentage are provided to MCRC for attainment.

MCRC divides the national goal between its two recruiting regions, using output from the Jareb-Parker model as a guide. Table 4 displays the FY01 diversity goals disseminated to Eastern (ERR) and Western (WRR) Recruiting Regions (MCRC, 2001). Note that the ERR received a larger share of the Black goal, while the WRR was expected to access more Hispanics and "Others" (e.g., Asians and American Indians).

PLC Diversity Goal	ERR	WRR	Total
Black	48	21	69
Hispanic	29	40	69
Other	39	54	93
Total	**116**	**115**	**231**

Table 4. Number of "Diversity" Contracts Required of Each USMC Recruiting Region, FY01. (Created by Author)

Each Region operates three recruiting districts, and has latitude in determining how to divide the goal among its districts. A colonel normally commands each district. District commanders apportion the goal down to any number of majors in command of recruiting stations. Figure 5 displays the boundaries of these Districts and Stations during FY 2001. The station goal is partitioned among one to three OSOs that operate out of that station. Most OSOs hold the rank of captain, though there are many first lieutenants and a few majors in the current OSO force.

Decisions at the District level are influenced by a major on the district staff known as the Assistant for Officer Procurement (AOP). An officer must have completed a previous three-year tour as an OSO to be considered for AOP duty. Commanders of districts and recruiting stations normally encourage daily interaction of the AOP and OSOs, and allow the AOP a great deal of influence in setting or changing recruiting missions for the OSO. This relationship can free the district and recruiting station commanders to dedicate more time to the much larger enlisted recruiting mission.

The Marine Corps currently employs 73 OSOs. Two of these OSOs recruit officers within the major operational commands located in Southern California and North Carolina. Figure 5 displays the distribution of the remaining 71 OSOs during FY01.

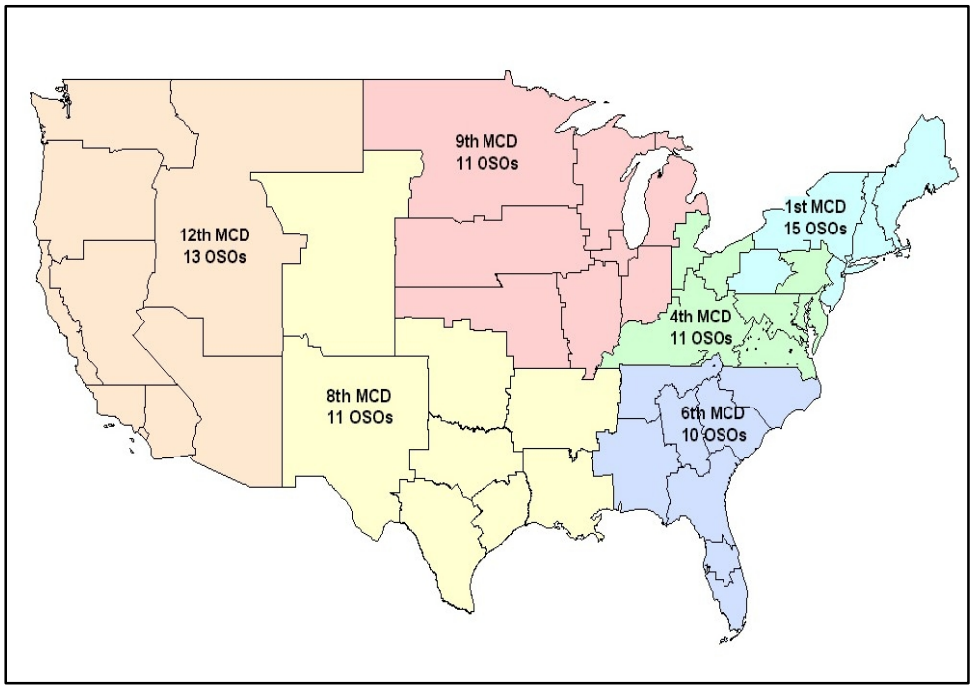


Figure 5. FY01 Recruiting District (Shaded Regions) and Station (Delineated within Shading) Boundaries, Showing Number of OSOs Assigned to Each District. (From: CNA, 2001)

4. OSO Activity

The OSO's daily activity is heavily influenced by geography, economics and the relationship of the AOP to the local Recruiting Station Commanding Officer (RSCO). The RSCO supports the OSO's daily operations by providing a budget, a staff for the OSO's office and coordination of testing services and medical examinations. Most OSOs operate out of a small office located in a commercial business complex, though some are located on military installations with the RSCO. They generally oversee a staff of two: a civilian secretary and a staff noncommissioned officer. Some OSOs share an office and supporting staff. OSO office location is based on the distribution of college students, the cost and availability of office space and the locations of testing and medical facilities.

The OSO's time is dedicated to recruiting, testing and preparation of candidates. When the OSO opens an application, he or she records the activity that drew the applicant to the recruiter, and credits a physical source where the contact first occurred. Table 5 lists the activities and organizations recognized by the officer recruiting structure.

Source	Remarks	Activity	Remarks
Area Canvass	The applicant met a recruiter out actively recruiting in public.	Canvass	The OSO initiated contact.
College Presentation	The applicant met a recruiter at a formal college presentation.	Enlisted Recruiter Referral	An enlisted recruiter referred the applicant.
Display Table	The applicant met a recruiter operating a display table at a formal function, i.e., college career day.	List	The OSO initiated contact based on a list of prospective leads generated by marketing efforts at a higher level.
Office Traffic	The applicant walked into the recruiting office.	Local Source	A local person—often a former Marine—referred the applicant.
Telephone Call	The applicant was contacted by telephone or email.	Marine Corps Reserve Referral	Applicant contacted the OSO based on an acquaintance in the reserves.
Home Visit	The recruiter was invited to the home of the applicant.	Pool Referral	Applicant contacted the OSO based on an acquaintance in the "pool" of "once-trained" candidates.
		TAD OSO	An officer on temporary assignment to the OSO office referred the applicant.
		Walk In/Phone In	Applicant initiated the contact.
		College Placement Referral	A member of a college placement office referred the applicant.
		Other	

Table 5. Recognized Source and Activity of Applicants. (Created by Author)

The distribution of sources and activities across geographic entities could offer information about the level of propensity, but only on the assumption that OSOs have been consistent in defining these measures.

C. THE JAREB-PARKER MODEL

The Jareb-Parker model is nonlinear and supported by a flat database. The function constructs three estimates, and then multiplies them to produce an estimate of QCP, by race, at any school in its database.

Mathematically, the model takes the form:

$$QCP_i = X_i Y_i \Sigma_r(\text{estimated full-time male enrollment}_{i,r}) \quad (3.1)$$

where:

X_i = estimated proportion of student body receiving bachelor's degrees each year

Y_i = estimated proportion of mentally qualified students among the bachelor's degree recipients

i = 1,..., 1,014 bachelor's degree awarding institutions

r = 1,..., 4 categories of race

CNA provided the model in both Microsoft Excel and Access formats. It contains no macros or other applications to generate or display its output. The estimates within the model were generated by simple column operations and macros contained within several extraneous spreadsheets and databases. Appendix A presents some summary information about the nature of schools in its database.

Figure 6 displays the flow of enrollment figures through the model. The first step develops the list of institutions on which QCP is based, removing those with fewer than 400 full-time enrolled male undergraduates during either 1997 or 1999. Jareb and Parker applied data from a variety of sources and years to arrive at their list. Enrollment figures are derived from Fall 1999 *Barron's College Admission Guide* reports, Fall 1999 *College Board Handbook* reports, or the U.S. Department of Education IPEDS Fall 1997 reports. Though IPEDS covers a much broader range of colleges and provides an official federal

measure of school enrollments, the Barron's figures predominate. Jareb and Parker felt the model would be better with the more recent figures (Jareb, 2002). Regardless of source, nearly 10,000 U.S. postsecondary institutions are filtered out at this step. This first step occurred on spreadsheets separate from the model; the results were copied into the model spreadsheet. The majority of excluded institutions are: specialized schools such as law colleges, medical schools and seminaries; colleges that award only associate's degrees; schools in the U.S. Territories; and nonaccredited schools.

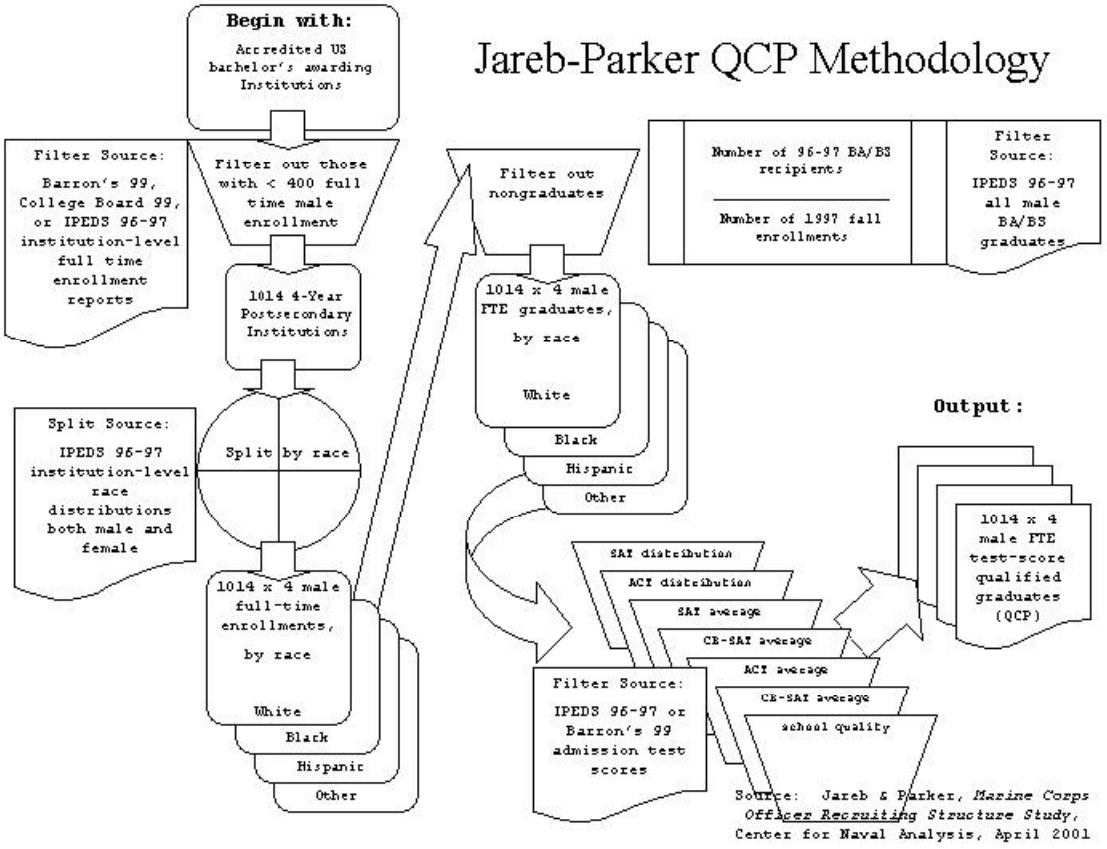


Figure 6. Jareb-Parker Model Schematic. (Created by Author)

The second step splits each school's full-time enrollment count along ethnic lines. Since Barron's does not publish enrollments by race, the model relies on IPEDS 1997 full-time male undergraduate enrollment figures, by race. Nonresident aliens are excluded from the count. The IPEDS figures are merely used to establish the 1997 distribution, by race, of the student body. These percentages are multiplied against the

1999 total enrollment figures to approximate male undergraduate enrollments, by race. The figures that emerge from this second stage in the model are thus neither 1997 nor 1999 figures, but more of a notion of what each school's male undergraduate body could look like at any time during the usable lifespan of the model, less nonresident aliens.

The third step breaks out an estimated number of bachelor's degree recipients from each school's undergraduate student body. The value of X_i in Equation 3.1 is determined by dividing the number of bachelor's degrees conferred during academic year 1996-97 by total 1997 fall undergraduate enrollment. Both figures are obtained from IPEDS. This third step results in an estimated count of each schools' notional baccalaureate cohort, by race.

Finally, the model reduces these notional baccalaureate cohorts by removing that proportion of graduates who would not be expected to meet the test eligibility requirements of the PLC and OCC programs. The value of Y_i in Equation 3.1 is established by any one of seven methods. Due to variation in college reporting, Jareb and Parker needed to develop seven different methods to estimate the proportion of graduates who met PLC and OCC testing eligibility requirements. Table 6 summarizes these methods by displaying that proportion of the database that applies the method (column titled "Share of Database"), the share of output generated by the particular method, the standard deviation of QCP determined by the particular method, the percent of QCP obtained by Historically Black Colleges and Universities (HBCU) within that method, and remarks about each distribution. Percentages may not sum to 100 due to rounding.

The method of "SAT Distribution" dominates the determination of QCP in all regions but the Central United States. It seems apparent that unreliability of some methods could lead to an inaccurate perception of the market in some regions of the country.

The model thus offers a utility not seen in previous officer market models. Its ability to estimate the market at the institution level should appeal to recruiting personnel at any level of the structure.

Method	Share of Database (# in database)	Share of National QCP	Standard Deviation of Method QCP	Percent HBCU	Remarks
SAT Distribution	62% (627)	75%	515	0.32%	Influenced by competitive, private schools
ACT Distribution	15% (151)	12%	341	0.56%	Influenced by central states
Combined SAT Average	9% (92)	6%	283	4.05%	Balanced
School Quality	5% (51)	2%	113	20.03%	Influenced by less-competitive schools and open-enrollment HBCU
SAT Average	4% (41)	6%	379	3.55%	Balanced
Combined ACT Average	3% (33)	1%	127	4.23%	Influenced by central states & public, less-competitive schools
ACT Average	2% (19)	1%	298	0.00%	Influenced by central states

Table 6. Jareb and Parker Methods for Estimating Test-score Eligible Proportion within Notional Baccalaureate Cohorts. (Created by Author)

IV. VERIFICATION OF THE MODEL DESIGN

A. DATA INTEGRITY

This study compared model data to IPEDS figures and to the documentation included with the model. In all cases considered, the IPEDS data matches the model. The methodology and source of figures are as explained in the documentation. Some transcription errors, however, were found between Barron's and the model.

First, three schools with an estimated full-time male enrollment fewer than 400 are erroneously included in the database. Table 7 displays these schools. After review of background information included with the model, this study believes each of these schools was included for a different reason.

Estimated Full-time Male Enrollment	School	Location	Method
360	U of Pittsburgh-Bradford	Bradford, PA	SAT Average
257	CUNY Lehman College	Bronx, NY	SAT Average
378	Livingstone College	Salisbury, NC	School Quality
Source: "QCP Estimates—Details" Worksheet of "QCP Estimates" Excel Workbook, CNA Officer Recruiting Structure Study, April 2001.			

Table 7. Schools in Database with Fewer than 400 Full-time Enrolled Men. (Created by Author)

The inclusion of the University of Pittsburgh-Bradford appears to be a mistake. 1997 IPEDS, 1999 Barron's and current enrollment figures all place its male enrollment below 400; it does not meet the standard. CUNY Lehman College appears not to meet the standard, but does. Transcription error apparently caused its enrollment to be reported far below its IPEDS 1997 figure of 1,239. Livingstone College appears to have experienced a large drop in full-time male enrollment between its 1997 IPEDS enrollment of 451 and 1999 Barron's report listed in Table 7.

This study also identified several institutions absent from the database but who were nonetheless productive. These schools are displayed in Table 8. The Automated Recruiting Management System (ARMS) shows that each of these colleges produced at least ten applicants.

Institution	1997 FTME*	Applicants in ARMS	Remarks
Indiana University East	689	76	None
Utah Valley State College	3,841	15	None
Lesley University, Massachusetts	195	11	Predominantly female college. 2000 FTME of 458; 5 applicants during 1989.
Park College, Missouri	244	19	None
Pensacola Christian College	NC**	14	4 per year 1999-2001
Silver Lake College, Wisconsin	87	23	None
Williams Baptist College, Arkansas	231	32	None
US Merchant Marine Academy	812	23	Service School
Parks Aeronautical College of the University of St. Louis	NC	10	Specialized engineering school
Embry-Riddle Aeronautical University—Prescott Campus	NC	40	Specialized engineering school
University of Phoenix	1,101	12	Specialized online business school.
*According to 1997 IPEDS data **NC. Not Considered by CNA enrollment screening and not in IPEDS			

Table 8. Exclusions from Model Database. (Created by Author)

Of the schools listed in Table 8, the exclusion of Indiana University East and Utah Valley State College is probably erroneous. The student bodies at Lesley University, Silver Lake College, Pensacola Christian, Park College and Williams Baptist appear to have a unique relationship with their OSOs; the numbers recruited from these schools are much higher than the numbers recruited from schools of similar size. The service and specialized schools were probably excluded due to their classification. Students with degrees from University of Phoenix can be located anywhere; thus it makes little sense to include this institution, since its demographics cannot be established. The specialized aeronautical schools, though not recognized as separate entities by IPEDS, are important

sources of aviation candidates. Interestingly, Embry-Riddle's main campus in Daytona, Florida is a member of the database.

B. ASSUMPTIONS

This section discusses the following assumptions that support the model.

1. Exclusion of Female Enrollment

The Jareb-Parker model bases QCP on male enrollment. Such a threshold would pose a problem if it suggested solutions that could adversely impact the ability of some recruiters to meet their female mission. The following discussion finds that this assumption does not pose a problem. As stated in the review of literature, this assumption has persisted for nearly three decades among enlisted market models, and the review noted no objections to the practice. The proportion of women among enlisted and officer recruits differs little. During FY99, women comprised 7.0 percent of Marine Corps active duty enlisted accessions, compared to 8.0 percent of active duty officer accessions (DMDC, 2000). A total of 242 women entered OCS through the PLC and OCC programs during FY01, suggesting that most OSOs were responsible for recruiting only 3 or 4 women during that year (OCS, 2000). Women also outnumber men on most campuses. The numbers suggest that this assumption simplifies the model without adversely affecting OSO mission accomplishment.

It is clear that female applicants are coming from the same schools as the male applicants. This study counted 1,381 records in the Automated Recruiting Management System that indicate a female applicant from a bachelor's conferring college. Of these, only 25 (1.8 percent) originated from schools with a full-time female enrollment exceeding 80 percent of the undergraduate population (i.e., women's colleges). These numbers suggest limited impact on current recruiting practice by exclusion of women's colleges from the database.

However, every respondent to the OSO Census believed that recruiting female PLC candidates was "Significantly Harder" or "Harder" than recruiting male candidates. A few respondents indicated that they perceived no difference in recruiting female or male OCC candidates, but these respondents were in the clear minority. While the model would presumably be more precise if it included women's colleges and female

enrollment figures, there seems little basis to suggest that inclusion of these features would improve the model's utility.

2. Exclusion of Schools with Fewer than 400 MFTE

The Jareb-Parker model bases QCP on schools with full-time male enrollment greater than 400. This assumption should be discussed on two dimensions: the threshold of *400*, and the threshold of *full-time enrollment*. The threshold of *full-time enrollment* would pose a problem if the programs accepted part-time students, which they do not. The threshold of *400* would pose a problem if a significant proportion of PLC and OCC applicants attended smaller schools, if the threshold caused the model to skew the distribution of minorities in the QCP, or if the threshold skewed the distribution of QCP in a geographic sense.

To identify the origins of officers commissioned out of the OCC and PLC program, this research matched the USMC college codes for each record in ARMS to the Federal Interagency Committee on Education (FICE) codes in the CNA QCP table. (The Marine Corps generates its own codes for postsecondary institutions, a practice at odds with the rest of the federal government and education community, which have been identifying postsecondary institutions by FICE since the early 1960s, or by U.S. Department of Education Institution ID since the advent of IPEDS during the late 1980s.) Of the 14,940 PLC and OCC records in ARMS, this study matched 14,613 (97.8 percent) of the records to FICE codes. The missing cells were either zeroes (208) or contained codes or schools that could not be matched to FICE codes. Officials at MCRC offer that it was common practice to place zeroes in a cell when an applicant attended or graduated from a school for which no USMC college code at the time existed. Most of the other unmatched codes appear to have been generated for small community colleges or specialized colleges within larger universities, or represent colleges such as Philips University of Enid, OK, which have since closed.

Ignoring the zero-coded records, ARMS PLC and OCC records suggest that 1,526 (10.4 percent) of applicants came from schools not included in the model. Of this group of records from outside the model's range, 221 records indicate an application from a specialized school (most frequently, law schools), 25 from a predominantly female

college, and another 636 (41.7 percent) from associate's colleges. A candidate cannot be commissioned without a bachelor's degree, so presumably these 636 associate's college applicants transferred into a bachelor's conferring program. So, of those 1,526 applicants whose colleges were excluded from the model, at least 644 remain who clearly appear to have graduated from a school with less than 400 FTME. Hence, it appears that only about four percent (644 of 14,613) of accessions through the PLC and OCC program obtain their bachelor's degree from schools with fewer than 400 FTME.

Responses to the Census of OSOs support the exclusion of these smaller schools from the computation of QCP. Most respondents (31 of 41, or 76 percent) reported visiting only one or two campuses per week, during a "typical" week. Each district prioritizes its assigned schools. When asked to estimate the number of hours per month spent at the highest priority campus, the median response was 28 hours. The census also indicated that an OSO spends on average 20 hours per month driving between campuses, though in New England (1st District) and in the states around Texas (8th District), this figure nears 30 hours. These responses suggest that the OSOs do not visit a large number of smaller campuses, but rather focus their efforts on the large campuses. Hence, the exclusion of schools with fewer than 400 FTME seems reasonable.

3. Exclusion of Two-Year Colleges and Law Schools

The Jareb-Parker model assumes that two-year colleges and law schools can, like women's colleges, be excluded from the determination of QCP without adverse impact on recruiting practices. This assumption would pose a problem if OSOs spent significant time recruiting on two-year and law school campuses. The preceding discussion found that only four percent (636) of contracts were generated in the junior colleges. Of the FY02 national recruiting mission, only four percent was dedicated to the Law component. The Census of OSOs finds that most OSOs (27 of 41, or 66 percent) never visit junior colleges, though one in five OSOs "prospect" at these schools on a quarterly or monthly basis. Recruiting is more active on law schools, where half of the respondents reported monthly or quarterly prospecting at law schools. Still, half reported visiting law schools "Once or twice a year" or "Never." As with the issue of female enrollment figures, the model would clearly benefit from this feature but from a national or regional standpoint,

there appears little reason to reject the model because it excludes associate's colleges and law schools.

4. Exclusion of Schools in U.S. Territories

The Jareb-Parker model excludes schools in the U.S. Possessions. Puerto Rico, Guam, the Virgin Islands and the Federation of Micronesia all operate four-year postsecondary institutions. The residents of these areas are U.S. citizens, eligible for commission in the armed forces. Both the College Board and IPEDS college directories confirm that many of these schools accept SAT or ACT scores for admissions. The Marine Corps does limited recruiting in these areas; 15 records in ARMS contain officers who were commissioned out of Puerto Rican colleges during the past two decades. These schools were excluded because a source of admissions test-score data for these schools could not be located within the constraints of the project; neither *U.S. News and World Report* nor *Barron's* discuss these schools. CNA paid for ACT scores by state; Puerto Rico and the other outlying areas were not included.

This research considered the impact of this exclusion. This exclusion could cause a noticeable understatement of QCP within the 6th Recruiting District, responsible for Puerto Rico. According to IPEDS, 28 schools in the outlying areas enrolled at least 400 full-time males during the fall of 2000 count of enrollments. All but one of these schools is located in Puerto Rico. During the academic year 2000-01, these 27 Puerto Rican schools conferred 4,971 bachelor's degrees on men. The enrollment of every one of these schools is 95 to 100 percent Hispanic (NCES, 2002).

The model suggests the Hispanic QCP for the 6th District is only 2,501. The potential test-score eligibility of the Puerto Rican graduates has not been studied, but the decision to exclude nearly 5,000 mostly Hispanic, successful college graduates may skew the 6th District market figures beyond the acceptable precision of the model.

5. Production, Based on the Ratio of Completions Over Enrollment

The model bases QCP on the ratio of 1996-97 bachelor's degrees conferred to 1997 total fall enrollment. Hence, it assumes that this ratio remains fairly consistent over the usable life of the model, and that the number of completions and enrollments adequately describe the eligible population. The assumptions would prove unsuited if

graduation rates varied significantly, or if the completions and enrollment figures included large numbers of ineligible persons.

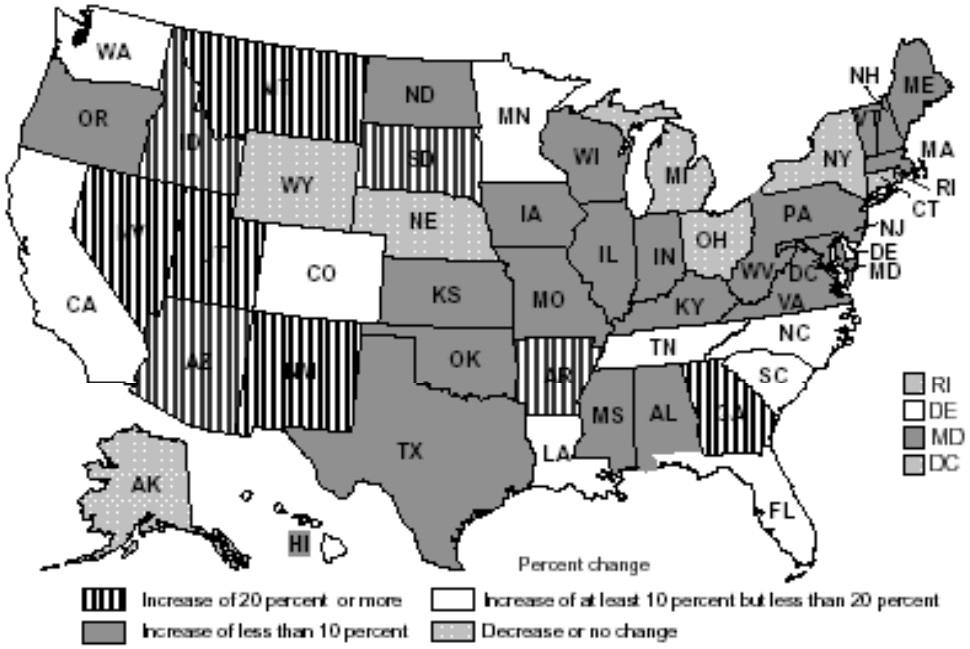
There exists no perfect measure of the population that interests the Marine Corps. Full-time enrollment figures from both IPEDS and the PLC program standards net students carrying at least 12 credit hours, so the model's enrollment figures match up to this requirement of the program. Completion figures are a different story. The number of 1996-97 completions counts all bachelor's degrees conferred between 1 July 1996 and 30 June 1997. Hence it includes second and third awards of a degree to a single graduating senior, and includes awards given to nontraditional students, i.e., adult and part-time students who earn their award at times other than the traditional spring commencement ceremony, as well as students who require more than four years to complete their degree requirements. Discussions with U.S. Department of Education officials suggest that the number of multiple awards is quite small, though actual counts of this number could not be obtained (Morgan, 2002). One expects a lot of model error to arise from use of IPEDS completion figures due to degrees conferred on nontraditional students. Discussion in Chapter V illustrates the degree of this error.

6. Distribution, Based on 1997 Figures

The size of each QCP forecast relies on Fall 1997 IPEDS figures that show the distribution of students, by race, within the entire student body. The model is static. To cover a lack of more recent data, it assumed that these proportions will not significantly change between 1997 and the time of model employment. There is no mechanism within the model to support time-series forecasting methods. Clearly, this could pose a problem in cases where schools experience rapid changes in their ethnic makeup.

The racial composition and geographic density of college populations fluctuate. Figure 7 shows that the total enrollment over the past decade in nine states increased by at least 20 percent, while the enrollment in six states and the District of Columbia did not change or decreased. To see if similar shifts could occur within schools in the model's database, this study obtained completion figures from IPEDS for the years 1996-2001. Figures 8 and 9 show that the proportion of White completions declined steadily over the five years, from 80 to 76 percent of all bachelor's completions. Growth in the other three

ethnic populations compensated, though the "Other" category grew fastest. Hence, in aggregate, the racial makeup of schools within the model's database shifted, in some cases by at least four percent, over a six-year period. Chapter VI discusses the dynamic nature of college populations in more detail.



SOURCE: U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), "Fall Enrollment" surveys.

Figure 7. Percentage Change in Total Enrollment of Degree Granting Institutions, by State: Fall 1990 – Fall 1998. (From: NCES, 2000)

These observations suggest that the static nature of the model will induce some error. The dynamic nature of ethnicity within the U.S. college population will ensure a short lifespan for the model unless the model gains an ability to be updated and to make time-series forecasts.

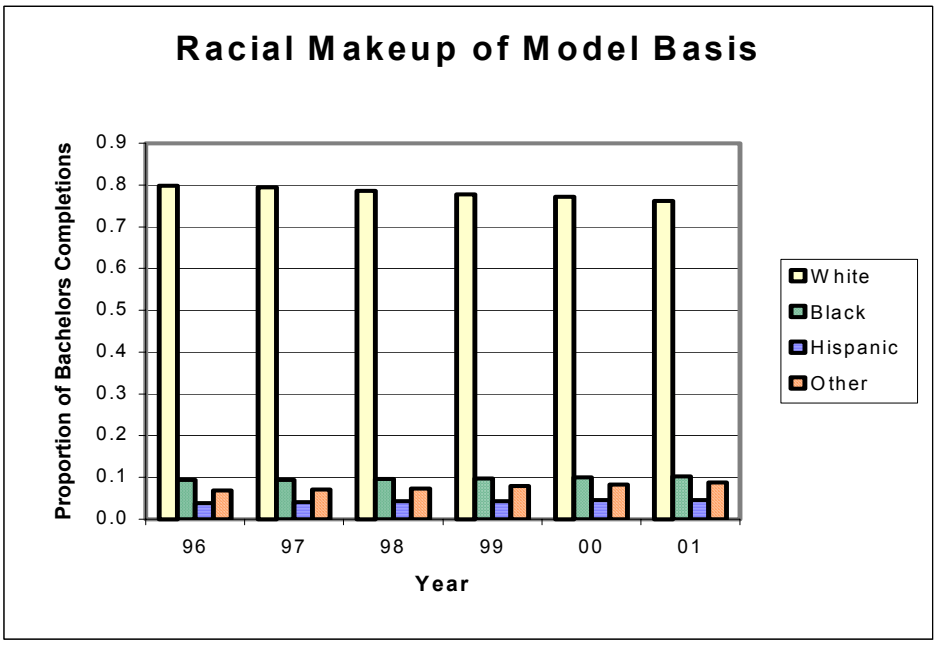


Figure 8. Shifts in Racial Makeup of Completions within the Model's Database. (Created by Author)

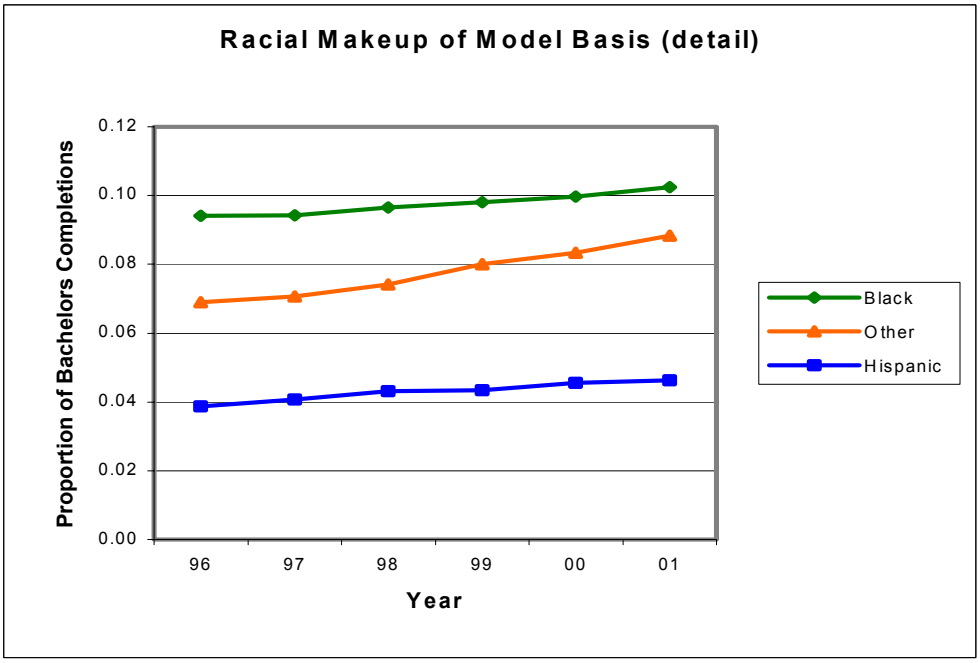


Figure 9. Detail of Shift in Racial Makeup of Model's Database. (Created by Author)

7. Concordance of SAT and ACT

"Concordance," or agreement, is the term used within the education establishment to describe a degree of equivalence between different types of admissions test scores. In the course of recruiting officer candidates and modeling the population, both MCRC and CNA have assumed concordance between certain levels of ACT and SAT performance. MCRC asserts that an SAT (Combined) score of 1,000 is concordant with an ACT (Math + English) score of 45. Because few sources report scores by ACT subtest, Jareb and Parker looked to the more popular ACT (Composite) score as a measure of potential test-score eligibility among a student body. The model assumes that during 2001, an ACT (Composite) of 22.5 is a concordant substitute for the SAT (Combined) score of 1,000. A flaw in either assumption could cause the model to measure different qualities, or draw from different percentiles of the same population. This study finds that both assumptions disagree with applicable guidelines.

Numerous studies have attempted to generate and validate concordance tables: tables that define appropriate substitutions of SAT and ACT scores. The College Board—the organization responsible for the SAT—publishes studies that validate the concept of concordance (Dorans, 1999; College Board, 1999). The organization also publishes concordance tables, and methods by which organizations can tailor their own tables. These tables are updated annually, for national test performance varies by year, region, sex and race of the test population.

The ACT is comprised of four subtests: Math, English, Reading, and Science Reasoning (Dorans, 1999). ACT performance is frequently measured by a composite score, which is merely the sum of scores on the four subtests, divided by four and rounded to the nearest tenth.

MCRC uses SAT (Composite) or ACT (Math + English) as the standard by which applicants are judged. The SAT (C) is a familiar measure of aptitude; many other organizations use it. The ACT (M + E) measure, however, is not commonly used. In fact, this project failed to find another organization or study that uses this measure.

Volume III (*Officer Procurement*) of the *Marine Personnel Procurement Manual* contains an ACT (Math + *Verbal*)-to-SAT (C) concordance table published during 1989. It serves as the 2003 basis for the Marine Corps aptitude test eligibility requirement. It is possible that the ACT contained a "verbal" subtest in 1989; the subtest names changed over the decade. This study was unable to determine if the current ACT English subtest measures equivalent aptitude.

The most recent *College Board* concordance tables do not find the ACT (C) of 22.5 concordant with an SAT (C) of 1,000. Table 9 summarizes concordance guidelines published by the *College Board* during 2002.

ACT Composite Score	Concordant SAT Composite Score	2001 College-bound Male Percentile	2001 College-bound Female Percentile
21	1,000	41	49
22.5	1,050	50	59

Table 9. Concordance of Relevant SAT and ACT Scores. (Created by Author)

Assuming MCRC retains its current SAT and ACT score eligibility requirements, Table 9 suggests that the Marine Corps will soon be drawing from the 41st or 49th percentile of college students, when approached by applicants with a recorded SAT score. Meanwhile, the methods within the model that apply ACT score—20 percent of the schools—draw from the 50th percentile. Within the United States, 592,000 college bound male students took the SAT during 2001; the area between the 41st and 50th percentile contains 53,000 of them. (College Board, 1999; Schneider and Dorans, 1999)

Incidentally, other studies suggest that the ACT (M + E) measures different qualities than the SAT (C). Dorans (1999), after reviewing studies of concordance and performing his own comparison, advises against comparisons between the SAT Verbal and any single ACT subtest. They simply measure different capabilities. He found that among all possible ACT measures, the ACT (Sum) showed the strongest correlation to

SAT (Combined) performance. Hence, Jareb and Parker may have improved on the measure of student population aptitude by applying the ACT (C) rather than the ACT (M + E), but the model measures a different quality than that measured by OSOs when they review an applicant's test scores.

The difference of opinion between MCRC, CNA and educational testing studies could stem from a 1995 decision to recenter SAT scoring. The score was recentered to reflect the changing pattern of college participation in the U.S. population. When the SAT was developed, most participants were White students at superior high schools. As other sectors of the population began to apply to college in large numbers, it was found that social and economic factors seemed to affect SAT performance. The recenter became necessary to fasten the middle score of the test to the median of a changed test-taking population. The recenter first affected high school students applying for admission to the 1996 fall freshman cohort. Scores of 420 Verbal and 470 Math shifted to scores of 500 (College Board, 1999). MCRC standards did not keep step with this change in scoring; its 1989 concordance table remains in effect (MCRC, 2002). Six freshman cohorts have since entered college with recentered SAT scores. This study estimates that the shift and subsequent failure of MCRC to conform created a situation in which over one quarter million males between the ages 18 and 24 are currently eligible under SAT, but not ACT, eligibility requirements.

Hence, the model attempts to measure the test-score eligibility of ACT-reporting institutions slightly differently from the manner in which MCRC would measure it. With either assumption, this study expects the size of QCP based on ACT score threshold of 22.5 to underestimate the actual number of students who are capable of meeting MCRC EL or SAT test-score eligibility standards. The model's application of the ACT (C) is probably an improvement over application of the ACT (M + E). In future years, MCRC may gather enough data to support imputation of test-score eligibility at most institutions across the United States by reviewing the EL and General Qualification Test (GCT) scores of applicants from those schools. In the meantime, a score of 21 would be a more appropriate measure for ACT-reporting institutions.

V. VALIDATION OF THE MODEL'S OUTPUT

A. OVERVIEW

This study found that the model cannot be validated, because precise measurements of QCP cannot be obtained, for a variety of reasons. Few schools can accurately measure their QCP without a thorough review of every transcript of every graduate. The phenomena of varied admissions requirements, increasing migration and declining persistence result in a very diverse cohort of bachelor's degree recipients of which relatively few are persistent students with recorded SAT (C) admissions scores. The large population of transfer and nontraditional students within this cohort only allow for an imputed measure of QCP at most schools; such a measure, by the standards accepted by this study, provides an inadequate basis for validation.

During the 2000-2001 academic year, for instance, 19 percent of private four-year postsecondary institutions did not use admissions test scores for the admission decision (NCES, 2002). The survey of colleges received 48 responses with partial data or a refusal to participate. Of these 48 responses, 24 included some sort of explanation that indicated that the school lacked the ability to support a measure of QCP. Another 13 colleges indicated that they probably could estimate their QCP, but referred to policies that prevented them from releasing such information. Nearly 200 colleges simply did not respond.

That said, it may be worthwhile to compare the model's output to imputed measures of QCP that were obtained from survey respondents.

B. THE MODEL AGAINST IMPUTED OBSERVATIONS

1. Model of QCP

To estimate the accuracy of the Jareb-Parker model, this study developed its own model of QCP, used the model to estimate QCP at a sample of colleges from the Jareb-Parker database, and then compared the estimates to like observations from the Jareb-Parker model.

This study uses Venn diagrams to illustrate its QCP model. QCP estimates the size of the intersection of the set of attendance-eligible (full time) with the set of test-

score eligible (SAT = 1,000) bachelor's degree recipients, as shown in Figure 10. This study has developed a method to measure this population, a method that relies on imputation.

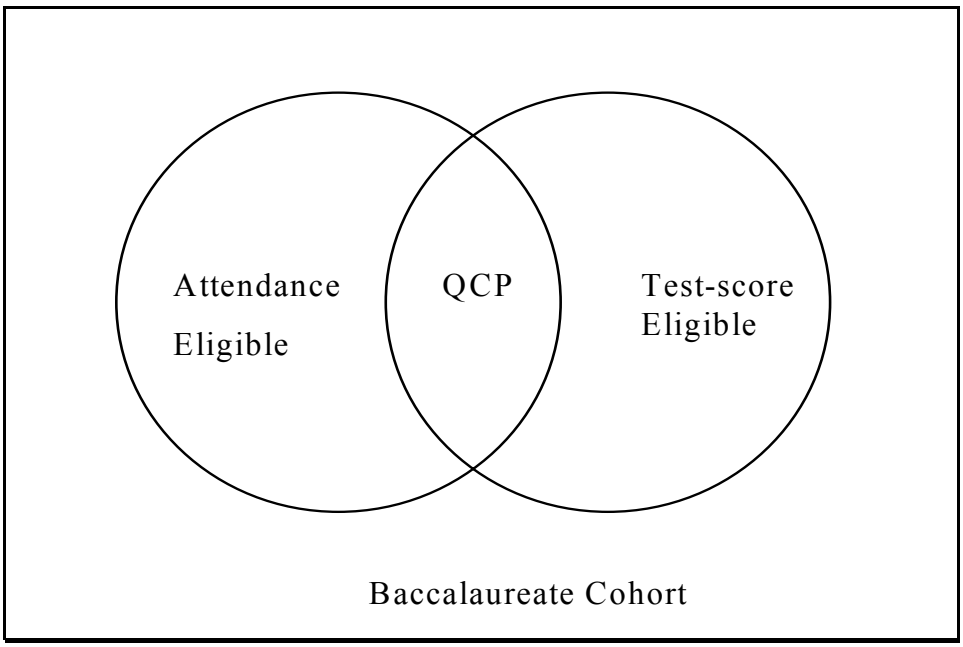


Figure 10. Venn Diagram Showing Components of QCP. (Created by Author)

Counting the test-score eligible graduates would seem straightforward, but is in fact complicated by colleges' use of various ACT measurements and by the presence of large numbers of matriculants without recorded scores. The proportion of observable student admissions scores within a cohort varies with school admission policy.

Counting the attendance-eligible set offers even more challenge. MCRC's officer procurement manual states that four-year students (i.e., students who complete bachelor's degree requirements within four academic years) should be the norm among officer program applicants. To identify this set of attendance-eligible students, Jareb and Parker used an annual autumn count of students enrolled and taking at least 12 credit hours.

As some students move between full- and part-time during their enrollment, and as some disenroll after being counted each year, the model measures more than just the number of graduates who were fully enrolled through their time in college. The CSRDE (2001) found that during the 1998 academic year, over 20 percent of beginning freshmen

failed to complete freshman year, so the use of these fall enrollment figures to measure the number of attendance-eligible students may incur noticeable error in some schools. The education establishment routinely tracks students from matriculation to graduation and can identify students who attended full-time through graduation at a single institution. These students persist in what IR officials refer to as a "cohort." But IR officials often cannot easily do the same for students who transferred in. Hence there are countable and uncountable sets of full-time enrolled students in any graduating class.

This study based its measure of attendance-eligible students on the countable set: these first time [in college] freshman (FTF) cohorts. This study includes five-year students within the set of full-time students. On the surface, this decision appears to contradict MCRC policy of making four-year students the "norm." There are three reasons to do this. Some baccalaureate programs—notably engineering programs—require five years for completion. The U.S. Department of Education definition of a bachelor's degree allows for five years. And finally, someone completing a four-year program in five years would still be eligible for one of the PLC programs at some point in their studies, and would be eligible for OCC.

Hence, this methodology views QCP as a function of eight different subsets of a year's baccalaureate cohort. QCP is comprised of four- and five-year persistent FTF and students who migrate but still complete their degree requirements within four or five years. Each of these four groups has subsets of students with and without admissions test scores on record. Figure 11 models QCP in this manner—from the standpoint of attendance (full- or part-time), source (transfer or persistent) and test-score eligibility (recorded or unrecorded score). The test-score eligible group is represented by nested circles, the inner circle representing students with a recorded test score, the difference representing students who could be shown to be test-score eligible but lack an admissions test score on record with the college in which they are currently enrolled. QCP may thus be seen as an interaction between six populations, which creates eight different groups that need counting. The ability of schools to count the size of these populations within any graduating class varies.

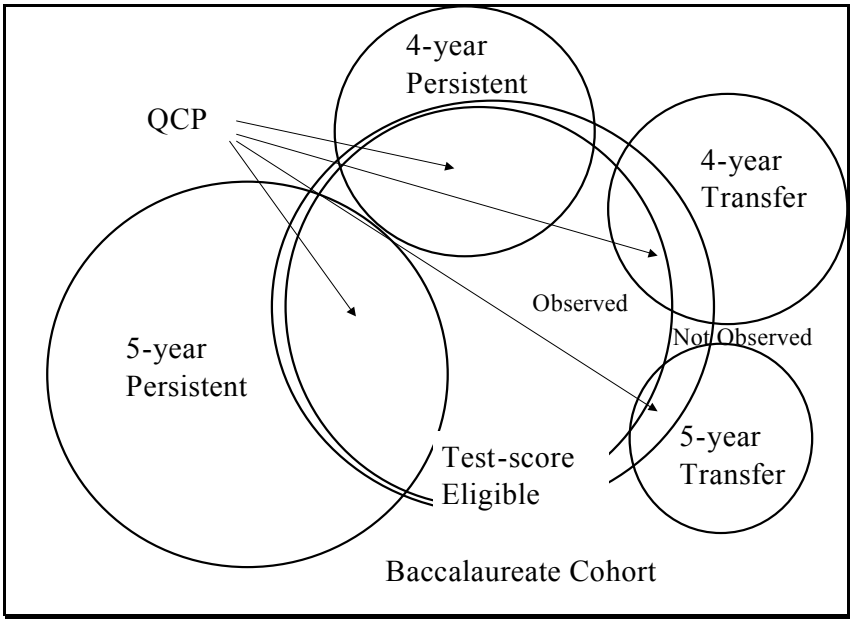


Figure 11. Expanded Venn Diagram of QCP. (Created by Author)

2. Measurement of QCP

Despite an inability to measure these quantities precisely, comparison of the Jareb-Parker model's output to these imputed measures of QCP provided insight into the model's behavior. To develop the imputed measure of QCP, the following counts were obtained from institutions: size of the baccalaureate cohort; number of four- and five-year FTF cohort (FTF) members within the baccalaureate cohort; number of transfer students within the baccalaureate cohort; number of students within the baccalaureate cohort who have an ACT or SAT score on record with the institution; and number of test-score eligible students within the cohort. To impute QCP, this study began by counting all bachelor's recipients provided by each college, as depicted by the box in Figure 12. The process was able to omit nonresident aliens from the cohort, but each cohort still includes an undetermined number of students with resident visas who are not U.S. citizens. In some cases, schools offered a count of FTF cohort members rather than the entire cohort; such cases were handled by substitution of completions figures from IPEDS. After establishing the size of the baccalaureate cohort, this study estimated the size of the attendance-eligible set, then attempted to count the number of test-eligible individuals within the attendance-eligible set.

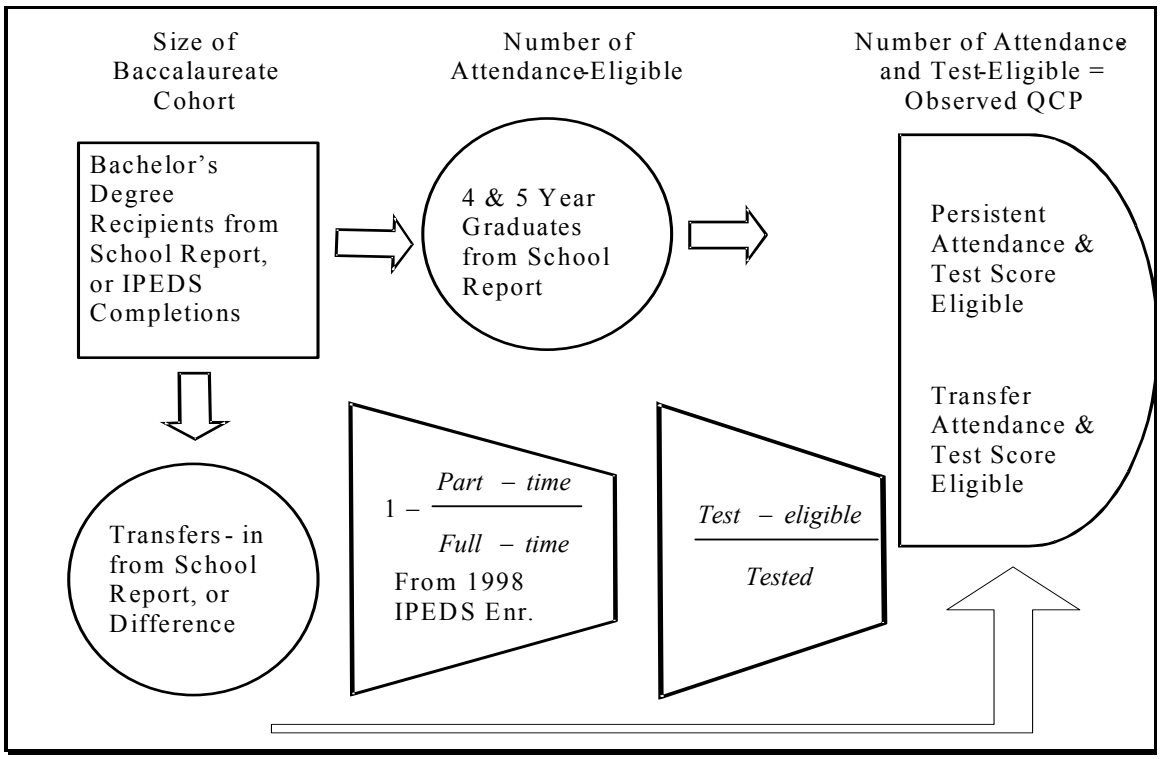


Figure 12. Method of Imputing QCP from College Observations. (Created by Author)

Attendance-eligible figures consist of four- and five-year FTF counts and an estimated number of transfer students who would meet the Marine Corps attendance eligibility standard, as depicted by the circles in Figure 12. Not all participants in the survey provided a count of transfer students within the cohort. If a school did count its transfer students, this number was reduced by the ratio of part-time to full-time male undergraduate students from the IPEDS 1998 fall enrollment report. If not, the entire remainder of the universe was reduced by the ratio. Either result imputed a count of transfer students who completed their degree requirements on a full-time basis. On average, 18 percent of a given baccalaureate cohort was of unknown attendance status and thus received this imputation treatment. This methodology recognizes aforementioned literature (Adelman, 1998) that finds that transfer students complete baccalaureate degrees in a time nearly on par with persistent students.

The third step of the method filtered out, from the attendance-eligible, those students who are known or suspected of not meeting USMC test-score eligibility. Among the FTF, participating schools routinely identified most of these students. Another imputation was required, though, to filter the students without recorded test scores. The filter rate was based on the scores of persistent students. Hence this method assumes that transfer students and persistent students without recorded test scores perform as well as persistent students who opted to submit scores during the admission process. Many studies, including this data set, suggest otherwise. The Ohio State University, for instance, provided test scores on nearly 500 transfer students. Observed test-eligible rates averaged 0.76 for four-year persistent, 0.66 for five-year persistent, 0.58 for four-year transfer and 0.56 for five-year transfer students over three years of observation. But in the interest of caution and due to the small size of the sample of tested transfer students observed by this study, the assumption was maintained. Over one-third (15 of 35, or 43 percent) of the records contained sets of full-time graduates with unknown score quality that outnumbered those with a known test quality. On average, 40 percent of the attendance-eligible graduates were of unknown test quality, and thus were considered test-eligible through imputation.

In several cases—especially during the analysis of QCP by race—a school reported fewer than ten test takers. Such a small number of observations provides a poor basis by which to establish a test-score eligibility rate. In such cases, a rate of 41 percent substituted, as the SAT score of 1,000 captures 41 percent of recent college-bound seniors (College Board, 2002).

3. The Estimator of Model Accuracy

At every school there exists an actual value of its QCP. The Jareb-Parker model estimates QCP at i = 1, ..., 1,014 of these schools, and within r = 1, ..., 4 different racial populations. A measure of model validity with any school would ideally be obtained through the use of a ratio of this estimate over the true value, which this study will call $\rho_{i,r}$. A measure of overall accuracy of the model could thus be obtained using the average of all $\rho_{i,r}$. Within a sample of $\rho_{i,r}$ the variable ***P*** itself has a mean, which this

study terms $\overline{P}$. As the $\rho_{i,r}$ come from populations of different sizes and variances, the use of their average or a mean observation may incur some limitations, but they may nonetheless be useful for summarizing the overall effectiveness of the model. However, the actual value of QCP could not be measured, so values of $\rho_{i,r}$ could not be ascertained.

To compensate, this study generated another set of estimates of QCP at some of these schools, through descriptive survey of the college IR offices, with additional imputation. To establish a measure of validity of the model, this study now compares the survey estimates to the Jareb-Parker model estimates, generating estimates of $\rho_{i,r}$, which this study calls $\hat{\rho}_{i,r}$. The overall measure of model effectiveness thus becomes the mean of the $\hat{\rho}_{i,r}$, $\hat{P}$ (or $\hat{P}_r$ when examining the model's effectiveness with different racial populations).

Hence, the ratio $\hat{P}$ serves to estimate the accuracy of the Jareb-Parker model. It does so by obtaining the mean value of $\hat{\rho}_{i,r}$ against any of $i = 1, \ldots, 1{,}014$ colleges and $r \in$ {one of four MCRC ethnic population categories or their aggregation: *White, Black, Hispanic, Other, Aggregate*}. Agreement between any college and model observations is thus established:

$\hat{\rho}_{i,r} > 1.0$ the model overstated the college estimate

$\hat{\rho}_{i,r} = 1.0$ the model and college estimates agreed

$\hat{\rho}_{i,r} < 1.0$ the model understated the college estimate.

4. Sampling Method

The sampling method employed by this study is subject to two restrictions. First, this study relies on restricted rather than simple random sampling. The study developed a random sample of the 1,014 schools within the database. This sample was then restricted, based on the ability of this study to contact an office or person within the college responsible for institutional research (IR). All colleges conduct some form of this research; in the smallest colleges, though, this is frequently a secondary duty of the

academic provost or registrar. Such colleges were generally excluded from the sample frame. The federal government and other organizations conduct this style of sampling when it is not cost-effective to survey a random sample of the entire population, or when a population is dominated by certain types of units, as here, where "SAT Distribution" schools dominate the Jareb-Parker model (Williams, 1978, Statistical Policy Office, 2001). This method of survey is often referred to as "cut-off" style establishment sampling. The sampling was done without replacement.

The sample faces a second restriction; it was also stratified by method of test-score eligibility determination, i.e., by "ACT Average," "ACT Distribution," etc. Williams suggests that this form of sampling may reduce sample error over nonrestricted forms of sampling. The sample was also stratified to ensure a sample representative of the model, as the different methods of determining QCP could vary in their accuracy.

5. The Data

The data were obtained through survey instruments emailed or FAXed to IR offices at postsecondary institutions around the country. When possible, the mailing was preceded by a phone call that discussed the survey and verified an address of the correct person to handle the school's response. Five versions of the survey instrument were employed; they are displayed in Appendix B. The first three versions only sought to obtain total QCP. The remaining versions attempted to capture QCP, by race.

Between January and March 2002, 177 surveys were sent to units within the sample frame. 152 cases were not completed; this first phase thus generated 18 complete interviews regarding aggregate QCP (a response rate of 11 percent). Between May and June 2002, another 113-unit sample frame was approached, with the intent of collecting more detailed information on either test-score eligibility rates or on QCP, by race. The second survey yielded 18 interviews about QCP, by race category, and another 10 interviews about test-score eligibility rates only (together, a 25 percent unweighted response rate), giving an overall unweighted response rate of 17 percent for the study, if one measures by responding units. One interview (University of Houston-Downtown) was not used because the college has an open admissions policy. The resulting data consist of three sets of observations: a set of 35 observations of aggregate QCP; a set of

14 observations of QCP by MCRC ethnic population category; and a set of 45 observations of test-score eligibility rates.

Every survey captures the persistence of first-time full-time enrolled freshmen (FTF) cohorts. As previously mentioned, these cohorts make up only a small measure of the entire graduating cohort. The mental qualification rate established by the school, for this FTF cohort, is applied to the remainder of bachelor's degree recipients for a given year. In cases where a school did not exclude nonresident aliens, the QCP was reduced by the average number of nonresident aliens within IPEDS completions figures for colleges in the entire Jareb-Parker database, which amounted to 0.03 for public, and 0.09 for private schools.

The following discussion of response rates and survey error pertains to the set of observations of aggregate QCP. The Statistical Policy Office within the U.S. Congressional Office of Management and Budget (2001) prescribes a method of weighting stratified response rates for federal survey data. This weighting methodology provides better information as to the degree that each stratum is covered by observation. It accords each sample unit a weight, w_i, which is the inverse of the probability of selection for unit i. It assigns binary variables I_i, R_i and NC_i to each unit, indicating if the unit was successfully interviewed, if the unit refused, or if the unit was not contacted. Given $i = 1, \ldots, n$ sample frame units, the weighted response rate may be given by:

$$\frac{\sum_{i=1}^{n} w_i I_i}{\sum_{i=1}^{n} w_i \left(I_i + R_i + NC_i \right)} \tag{5.1}$$

Applying Expression 5.1 to the sample suggests an overall weighted response rate of 14 percent.

6. Nonresponse Error

Nonresponse error describes the degree of unsuccessful attempts to interview units within the sampling frame. This survey discusses nonresponse error in the context of unit nonresponse, i.e., the degree in which units (colleges) ignored the survey or returned insufficient data (as opposed to question nonresponse, a common measure of

questions that respondents failed to completely answer). Table 10 displays the number of nonrespondents, by stratum. Prominent is the fact that five of the seven strata are supported by less than two interviews each.

This nonresponse error was found to affect the sample in two ways. First, the error eliminated consideration of five of the seven methods applied by Jareb and Parker. Second, the sample skews more towards larger colleges than either the population or the sample frame.

Stratum (Method)	Number in Model (pop.)	Percent of Population	Number Contacted (frame)	Percent of Frame	Number Interviewed (sample)	Percent of Sample	Number of Non-respondents
ACT AVG	19	1.9	7	2.5	0	0.0	7
ACT DISTBN	151	15.0	35	13.0	7	20.0	28
CB - ACT AVG	33	3.3	6	2.1	0	0.0	6
CB - SAT AVG	92	9.1	34	12.0	1	2.8	33
SAT AVG	41	4.0	14	5.0	1	2.8	13
SAT DISTBN	627	62.0	173	62.0	26	74.0	147
SCHOOL QUALITY	51	5.0	11	3.9	0	0.0	11
Total	1,014		280		35		245

Table 10. Nonresponse Error in Sample of Colleges. (Created by Author)

The failure to obtain significant observation on schools in five strata has noteworthy consequences, though the study was able to proceed without it. Table 10 shows that the "SAT Distribution" method became over-represented in the sample. Observations of "ACT Distribution" are more representative of the population. These two methods apply to 77 percent of the schools in the population, so even though five strata were unsampled, the analysis could still examine nearly 80 percent of the model's behavior.

Next, the nonresponse error exacerbated the sampling restriction against small colleges within the population. Figure 13 plots the density of total male bachelor's completions within the population, the sampling frame and the sample.

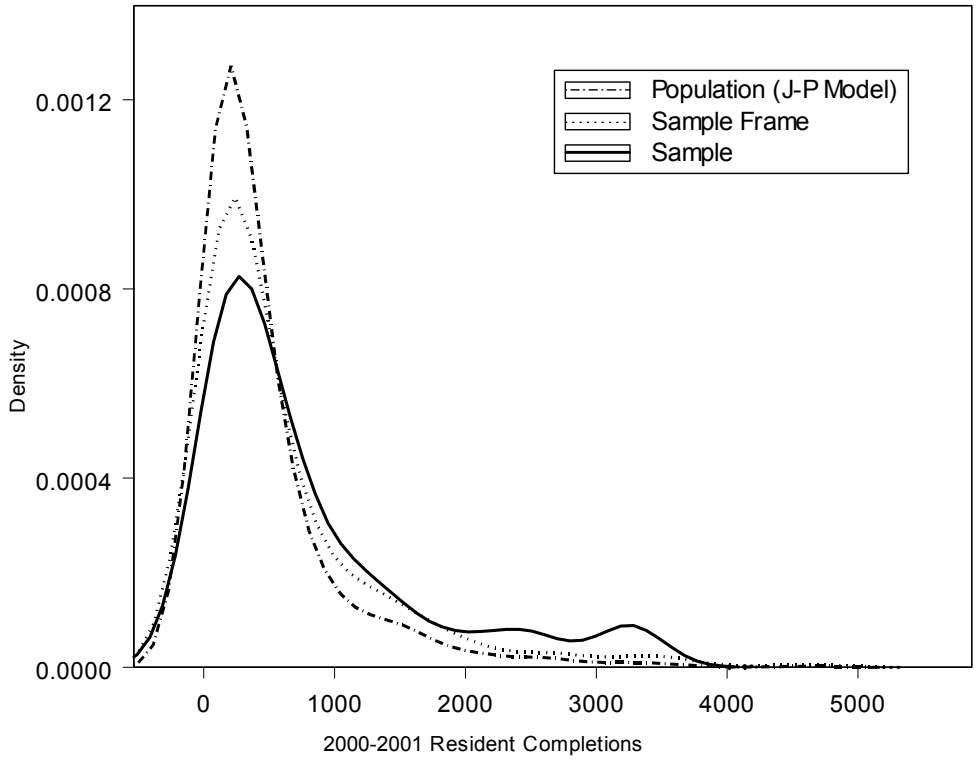


Figure 13. Plots Showing Density of Population, Sampling Frame and Sample of Colleges Surveyed. (Created by Author)

The thicker tail and peaks in the 2,000 – 4,000 completions range of the sample and sampling frame curves visually demonstrate that the sample frame and sample rely more on larger schools than the population. This study confirmed the visual with a quantitative finding that the sampling frame and sample have a different distribution than the population. The population, in this survey, is in fact a sample of the entire U.S. college population. The Kolmogorov-Smirnov test for comparing two populations (two-sided) is suitable for measuring the departure of two samples from a given population. This test generates step-wise cumulative density functions for each sample, and then measures the distance between the two functions. Critical values are obtained from the Kolmogorov-Smirnov "Maximum Value of Distance" table. When applied to compare completions in the Jareb-Parker model population with the sampling frame, the test rejected a null hypothesis that they have the same distribution ($p = 0.038$), confirming the

effect of restricting the sample. The sampling frame is different than the population of schools. The sample, though, does not differ from the sampling frame at the 0.95 significance level. The completions distributions of the sample frame and sample were compared using the Kolmogorov-Smirnov test, again with a null hypothesis that they have the same distribution. The test failed to reject the null hypothesis ($p = 0.34$), suggesting that the empty strata in the sample do not affect the distribution. So, despite the nonresponse error, the sample is similar to the sampling frame, at least in terms of the size of the baccalaureate cohorts.

Table 11 compares the sample of schools that provided a count of aggregate QCP against the model population, by other measures, such as mean QCP and Barron's Ranking. The effect of empty strata is evident in the "Proportion by Method" row.

Schools within the sample exhibit a higher mean, median and variance of QCP. Comparison of values in Table 11 shows that schools within the sample also tend to be more public and more research-oriented. Appearances of the two most common Barron's Rankings are similar, but otherwise ("Very Competitive" and "Competitive"), the two groups show inverse trends, with the sample being the more competitive.

Finally, the sampling succeeded in covering each recruiting district. Figure 14 plots the counties of the schools, along with the names of the schools that provided counts of aggregate QCP. The study obtained between four and nine observations within each district's boundaries (displayed in Figure 7). After viewing the geographic distribution of sampled schools, this study assumes that the data allow for statistical inference from the sample to the population of colleges for the "SAT Distribution" and "ACT Distribution" method schools within the Jareb-Parker database. The study cannot infer anything about the accuracy of the other methods developed by Jareb and Parker, such as "School Quality."

	Sample (College-estimated QCP)		Population (Model-estimated QCP)	
n	35		1,014	
Mean QCP	539		309	
Median QCP	282		148	
QCP σ	655		453	
Proportion by Method [applied by model]	ACT AVG	0.000	ACT AVG	0.019
	ACT DISTBN	0.200	ACT DISTBN	0.149
	CB - ACT AVG	0.000	CB - ACT AVG	0.033
	CB - SAT AVG	0.028	CB - SAT AVG	0.091
	SAT AVG	0.028	SAT AVG	0.040
	SAT DISTBN	0.728	SAT DISTBN	0.618
	SCHOOL QUALITY	0.000	SCHOOL QUALITY	0.050
Proportion by Control	PrivateNFP	0.46	PrivateNFP	0.53
	Public	0.54	Public	0.46
Proportion by Carnegie Classification	Baccalaureate General	0.086	Baccalaureate General	0.137
	Baccalaureate Liberal Arts	0.200	Baccalaureate Liberal Arts	0.147
	Baccalaureate/Associate's Colleges	0.000	Baccalaureate/Associate's Colleges	0.010
	Doctoral Research Univ Extensive	0.286	Doctoral Research Univ Extensive	0.146
	Doctoral Research Univ Intensive	0.114	Doctoral Research Univ Intensive	0.094
	Faith Related	0.000	Faith Related	0.003
	Master's Colleges & Universities I	0.286	Master's Colleges and Universities I	0.377
	Master's Colleges & Universities II	0.029	Master's Colleges and Universities II	0.060
Barron's Group proportion	Very Competitive	0.229	Very Competitive	0.220
	Highly Competitive	0.143	Highly Competitive	0.076
	Most Competitive	0.170	Most Competitive	0.049
	Competitive	0.343	Competitive	0.384
	Less Competitive	0.086	Less Competitive	0.188
	Non Competitive	0.029	Non Competitive	0.075

Table 11. Comparison of Sample and Population of Colleges. (Created by Author)

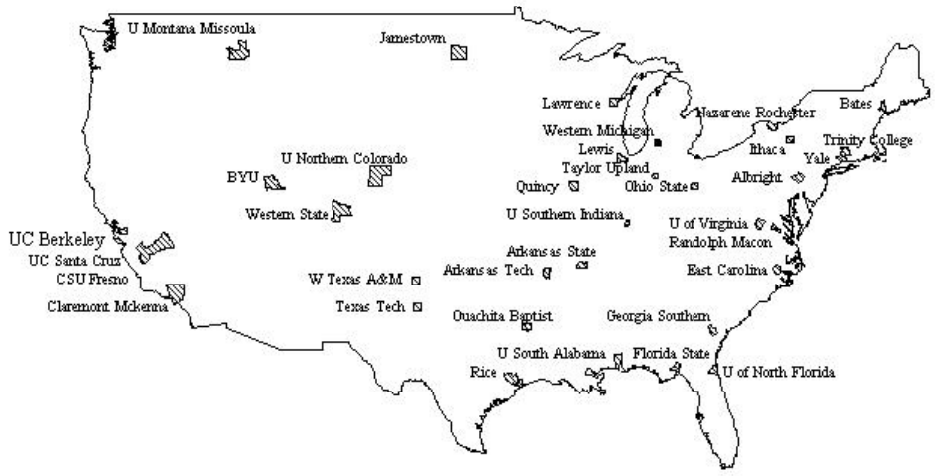


Figure 14. Location of Colleges that Provided Observations of QCP. (Created by Author)

7. Sampling Error

Every survey is subject to some degree of sampling error. Williams (1978) defines sampling error as the degree of error induced from measuring a sample of the population. It is based on the probability of an observation being drawn from within its stratum. He expresses sampling error for stratum i,

$i = 1, \ldots, n$ as:

$$\sum_{i=1}^{n}\left(\frac{M_i}{M}\right)\left(1-\left(\frac{m_i}{M_i}\right)\right)\left(\frac{s_i^2}{m_i}\right) \qquad (5.2)$$

where:

M is the number of sample units

M_i is the number of sample units within stratum i

m_i is the number of interviewed cases within the ith sample

s_i^2 is the estimate of the variance within stratum *i*

Applying Expression 5.2 suggests that the sampling error for the strata covered by the survey is ± 2 %.

8. Analysis

The college-reported/imputed observations of aggregate QCP nearly agreed with the Jareb-Parker model's predictions. Values of $\hat{\rho}_{i,r}$ will center on the value of 1.0 if the model and the imputation both accurately measure QCP. Figure 15 plots the 35 observations of $\hat{\rho}_{i,r=aggregate}$. The observations are ordered along the x-axis alphabetically. Any point located above the y = 1.0 line indicates a model estimate higher than the college reported/ imputed observation. The chart shows that the model output tends to exceed college observations, but only by 10 percent on average. The mean value of $\hat{\rho}_{i,r=aggregate}$ over the 35 observations equals 1.10; its standard deviation is 0.29. Appendix C displays the observations in detail.

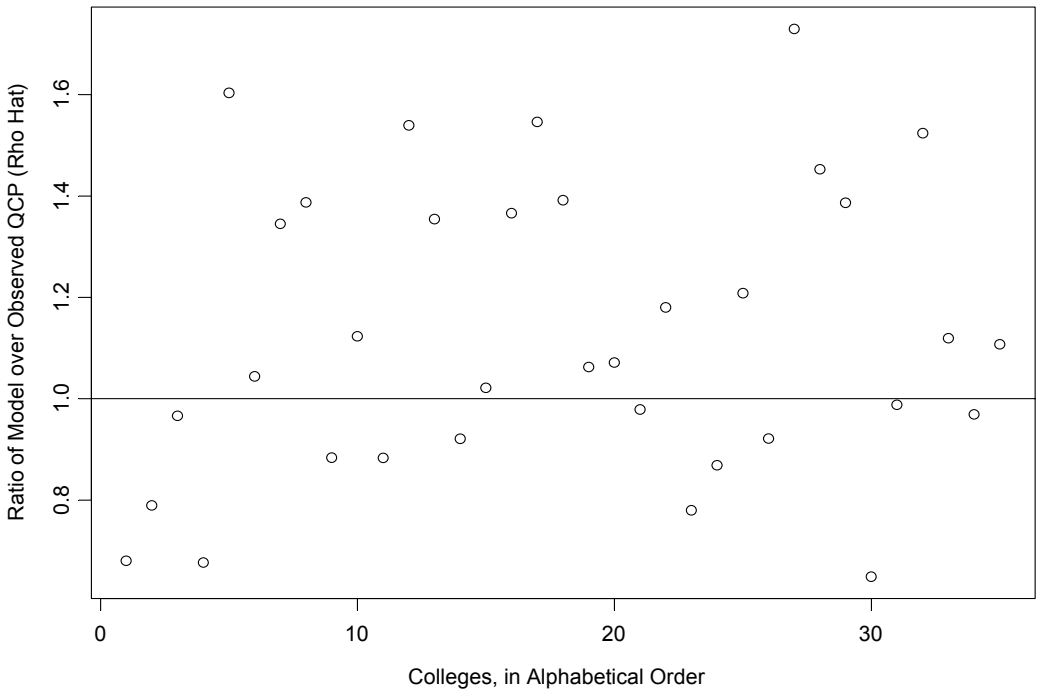


Figure 15. Scatterplot of Observations of Rho Aggregate. (Created by Author)

This study attempted to determine the likely true value of ***P***, which may be estimated as $\hat{P} = \frac{\sum_i \hat{\rho}_{i,r=aggregate}}{n}$ over the n = 35 observations. The observations $\hat{\rho}_{i,r=aggregate}$ have an asymmetric distribution. Such a distribution invalidates the use of parametric or signed-rank tests to compare the different values of $\hat{\rho}_{i,r=aggregate}$. The bootstrap method was thus applied to determine $\hat{P}$. After 1,000 replications, $\hat{P}$ was observed to lie at 1.13, with a standard error of 0.047. Corrected for bias, the study obtained a 95 percent confidence interval for $\hat{P}$ between [1.05, 1.21]. This study thus asserts that the Jareb-Parker model overestimates *r = aggregate* QCP between 5 and 21 percent. The reasons for this disagreement are examined in later paragraphs.

This study closely examined the lowest and highest observations in the sample; selected qualities of colleges that observed the highest three and lowest four values of aggregate QCP are displayed in Table 12. No clear trends emerged that would explain the differences. Variance in $\hat{\rho}_{i,r=aggregate}$ appears to be due to changes in conditions unique to any one institution, rather than any evident structure within the model.

School	University of Southern Indiana	Albright College	Bates College	The University of Montana-Missoula	Ouachita Baptist University	Brigham Young University	University of North Florida
State	IN	PA	ME	MT	AR	UT	FL
Rho Hat agg. by race	0.65	0.68	0.68	0.78	1.55	1.60	1.73
Method	SAT DISTBN	SAT DISTBN	SAT DISTBN	SAT DISTBN	SAT DISTBN	ACT DISTBN	SAT DISTBN
Count of 2000-01 Baccalaureate Cohort	350	115	199	764	135	3,361	689
Control	Public	Private	Private	Public	Private	Private	Public
Full-time Test - Eligibility Rate	0.65	0.66	0.99	0.67	0.73	0.88	0.80
Carnegie Classification	Master's Colleges and Universities I	Baccalaureate Liberal Arts	Baccalaureate Liberal Arts	Doctoral Research Univ Intensive	Baccalaureate General	Doctoral Research Univ Extensive	Master's Colleges and Universities I
Barrons Rating	Less Competitive	Less Competitive	Most Competitive	Compe-titive	Very Competitive	Highly Competitive	Very Competitive

Table 12. Comparison of Lowest and Highest Observations of Rho (hat), Aggregated by Race. The Leftmost Column Contains the Lowest. (Created by Author)

Before examining possible reasons for the observed disagreement between the college and model observations of $\hat{\rho}_{i,r=aggregate}$, the study considered $\hat{\rho}_{i,r}$ and finds evidence that Black QCP may be largely overstated, while QCP for the other races may be both more accurate and less variable between schools. Figure 16 displays observations of $\hat{\rho}_{i,r}$ for $i = 1, \ldots, 14$ schools that provided such data and $r \in \{$*White, Black, Hispanic, Other*$\}$. QCP counts for $r =$ *White* and $r =$ *Other* appear less variable, and closer to the model's predictions, than those of the other two races. This study finds that Black and Hispanic students, in this small sample, are more likely to be part-time or transfer students. Also, the mean predicted QCP from schools in this sample is very small for Black students; only four schools in the sample (Arkansas State University, University of California at Berkeley, Texas Tech University and Western Michigan University) have a predicted Black QCP of at least 20. Hence the figures for Black students are more sensitive.

But in four cases, the model indeed appears inaccurate. California State University, Fresno (CSU Fresno) reported 37 Black bachelor's recipients, and only one was a persistent full-time student with a confirmed test score that met or exceeded Marine Corps standard. Lewis University—a "Competitive" private school located in Illinois—conferred bachelor's degrees on 24 Black students during the same year, but the survey offered that only two of them were persistent, full-time students with a recorded ACT (C) that met or exceeded a score of 21 (indicating that they possibly could be expected to meet or exceed Marine Corps standard). As with CSU Fresno, the majority of Black students transferred in from other institutions; their high school admissions scores are unknown and so imputed by national performance score. Similar observations may be made of University of California at Berkeley (UC Berkeley) and Arkansas State University, where only 14 of 93, and 5 of 42, Black graduates could be confirmed as attendance- and test-score eligible.

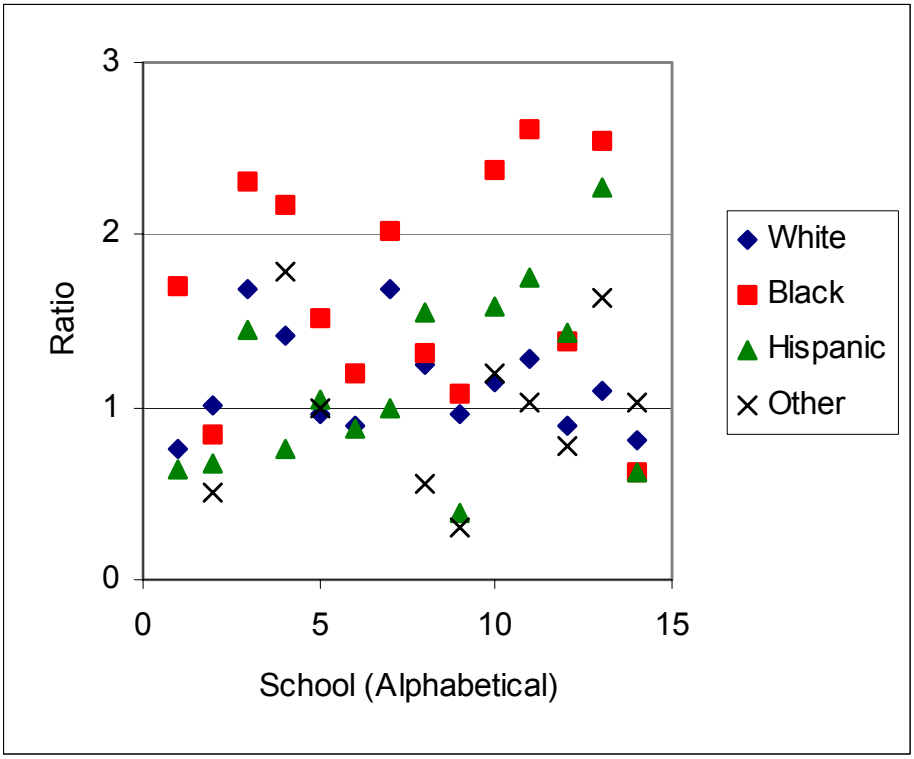


Figure 16. Scatterplot of Observations of Model Predictions to College/Imputed Observations of QCP by Race (Rho). (Created by Author)

This perceived overestimation of Black cohort counts by the model may be due to inadequate imputation methods with the transfer students, but the nature of admissions score testing suggests that this outcome is not unexpected. *The large difference between the model and observations for Black students probably reflects their documented lower performances, as a group, on college admissions tests.* The College Board (2001) reported that among high school seniors bound for enrollment in college during the fall of 2001, test takers who described themselves as Black males scored 100 points less, on average, than White males on the SAT I Verbal and 114 points less on the SAT I Math. Students in all other categories, in fact, outperformed Black students. The model does not account for race in its count of test-score eligible students; its test-score eligibility rates are based on the score distributions of aggregate matriculants and are thus influenced by the larger number of higher-scoring White students. Thus it should count more Black students as "qualified" than who actually are, when actual high school admissions test scores are examined.

Table 13 compares model and observed QCP, by race. Data in the table confirm that the model overestimates the numbers of qualified Black graduates by a greater margin than the other races. The model predicts that these participating schools will, on average, produce 20 qualified Blacks, whereas the observations suggest the count is ten. The model seems to underestimate the count of qualified graduates of "Other" races. If one averages the value of $\hat{\rho}_{i,r}$ for $r = Black$ only for the seven schools with at least 15 Black baccalaureate recipients, the mean value of $\hat{\rho}_{i,r}$ equals 1.90. Hence, the evidence suggests that the model may overestimate the number of qualified Black candidates by as much as 90 percent, though the next paragraph suggests the actual number may be lower due to bias imposed by students for whom race was not indicated.

The apparent underestimation of "Other" students should not be taken to mean, though, that the participating colleges enroll more qualified "Other" (Asian-American and American Indian) students than are forecast by the Jareb-Parker model. When surveyed, colleges were asked to include within the "Other" count those students for whom race was not indicated. These numbers were not expected to be large, but as it turns out, in some cases, they are. For example, during 1997 UC Berkeley conferred bachelor's degrees to 1,346 students of the "Other" races and to 211 students of unknown race. Hence, the observed values of $\hat{\rho}_{i,r}$ for $r = Other$ may be biased slightly upwards, and biased slightly downwards for $r \in \{White, Black, Hispanic\}$ due to survey design.

	Mean $\hat{\rho}_i$	Predicted QCP from Sample of Jareb-Parker Model (mean, σ)	Imputed Observations of QCP (mean, σ)	Number of Graduates Over Estimated by Model (mean, σ)
White	1.13	567, 781	454, 495	113, 320
Black	1.69	20, 25	10, 9	10, 16
Hispanic	1.15	54, 84	37, 50	17, 36
Other	0.88	132, 344	165, 373	−4, 27

Table 13. Comparison of Predicted and Observed/Imputed Observations of QCP, by Race. (Created by Author)

The following two figures may provide more insight into the model's performance with race: the two observed methods are fairly consistent, and the magnitude of average model error rarely exceeds 100 graduates. Figure 17 plots $\hat{\rho}_{i,r}$, by race and clustered by college. The extension off the chart for *r* = *Other* races at Ouachita Baptist University may be attributed to variation in a very small population, rather than a gross structural error or data inconsistency. The model's performance against the imputed observations appears fairly consistent across schools. No patterns emerge by control or size of school. Figure 18 shows the difference between the model's predictions and the imputed measures in terms of raw number of graduates, rather than as a ratio. Nine of fourteen schools show an underestimation of QCP with one race category, usually White or Hispanic. The chart suggests that overestimations translate into an overstatement of White and Hispanic QCP at a large, "Most Competitive" school like UC Berkeley by 220 or 150 graduates, but in most cases, the disagreement is less than 100.

The extreme exceptions may be explained. Overestimation of White qualified graduates at Brigham Young University (BYU) actually extends off the chart to the figure of 1,100 graduates. This disagreement probably reflects a difference in counting both the attendance and test-score eligible subpopulations. A majority of students at BYU—90 percent, according to institutional research officials at BYU—interrupt their studies to pursue a religious obligation that normally lasts two years (Curtin, 2002). The Jareb-Parker methodology counted every student who was enrolled full-time at a particular moment, regardless of how many years the student was previously absent. This study, on the other hand, disregarded many of these students who went on a religious mission, as the mission would disqualify them for the PLC Junior program. Actual test-score eligibility was five percent lower than estimated by the "ACT Distribution" method, possibly due to the aforementioned concordance and SAT recenter issues. The overstatement of Hispanic QCP at UC Berkeley reflects an actual 16 percent drop in male Hispanic bachelor's degrees conferred 1997–2001, and perhaps lower test scores and higher migration than accounted for within the model.

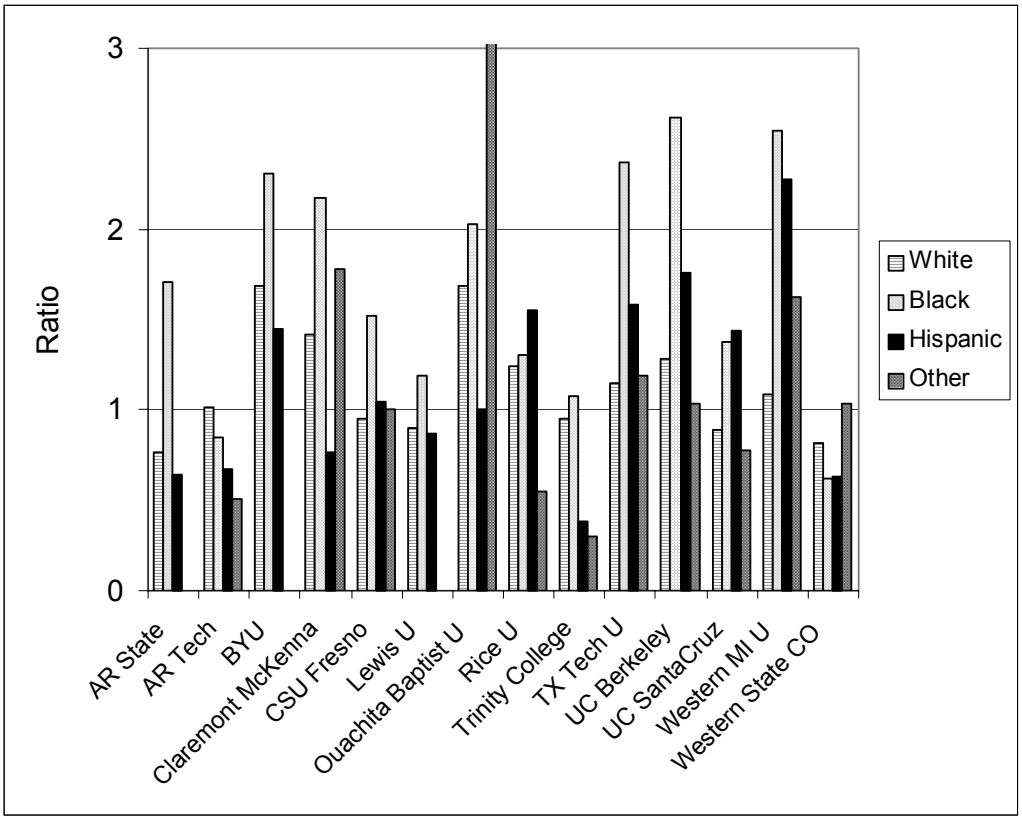


Figure 17. Observations of Rho (hat), by Race, at 14 Colleges. (Created by Author)

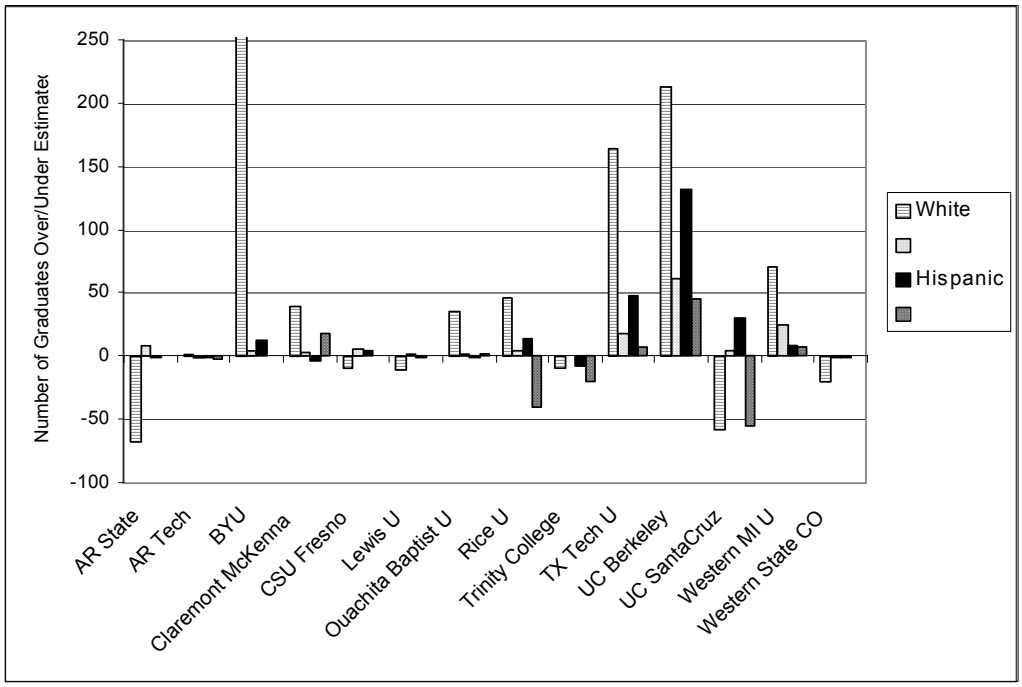


Figure 18. Over- or Under-Estimation of QCP, by Race, at 14 Colleges. (Created by Author)

Unfortunately, the sample lacked sufficient observations to enable comparisons between recruiting regions. The accuracy of the Jareb-Parker model still appears to depend on local conditions. No clear pattern emerged from the sample. This study concludes that the Jareb-Parker model is fairly accurate in estimating qualified candidate populations by race, though more often than not, it will overestimate the number of qualified Black students.

Variation between the predicted and observed QCP values may be due to some or all of the following factors:

- change in baccalaureate cohort size between 1998 and 2001;
- change in proportion of full-time students, or inadequate measure of it;
- change in proportion of test-eligible students, or inadequate measure of it;
- inadequacy of the imputation; and
- count of "race not indicated."

This study next examined the degree to which the variation may be due to test-score eligibility inaccuracies. Through the survey process, this study obtained a precise measure of full-time bachelor's recipient test-score eligibility rates. Analysis of the difference between these rates and the model's rate improves understanding of the model's performance.

This dataset consists of observations of test-score eligibility rates from 45 unique colleges, taken during the spring or fall of 2000. There is no imputation in these observations; they represent real measurements of baccalaureate cohorts taken by school IR officials. They are presumably independent, and the differences between the Jareb-Parker model rate and the rate observed by college institutional research officials have an approximately normal distribution.

Figure 19 displays four views of the difference between the model and observed test-eligibility rates. These plots support the assumption of normally and independently distributed observations that are free from influential observations. This claim was supported with a Kolmogorov-Smirnov Test of Composite Normality, which found

insufficient basis (p = 0.5) to reject a null hypothesis that stated the distribution is from a normal population. The samples are then compared with a parametric test: Student's t Test, with a null hypothesis that the true population difference between the average observation and average prediction is zero and an alternative hypothesis that the difference is not zero, i.e., a two-tailed test.

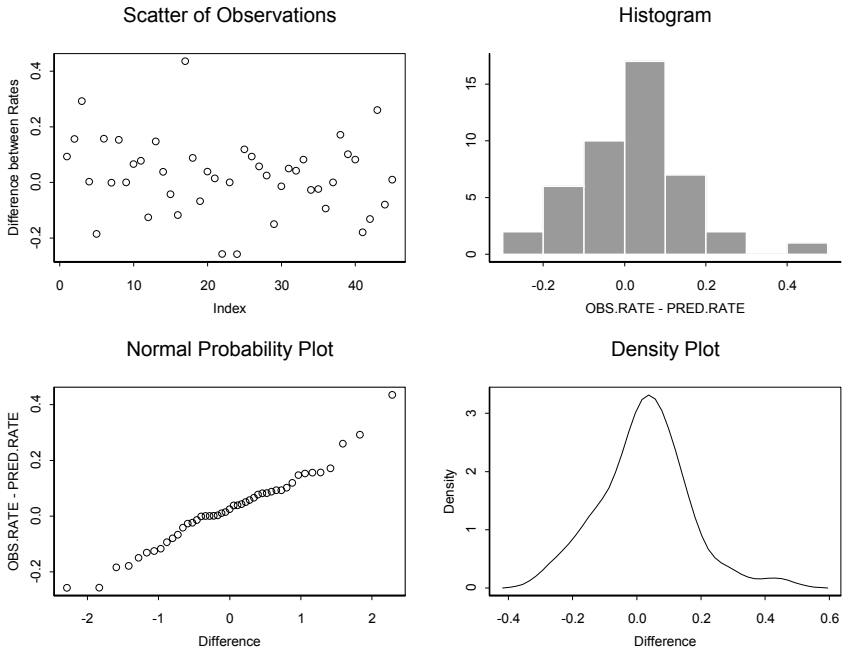


Figure 19. Four Views of the Differences Between Observed and Predicted Test-Eligibility Rates. (Created by Author)

This study finds insufficient evidence to reject the null hypothesis (p = 0.24). The model and imputed values appear to agree on test-eligibility rates within baccalaureate cohorts. The test estimates that the true mean difference between observed and predicted rates equals 0.024, and that it lies within the confidence interval [−0.0165, 0.0652]. There is insufficient basis to reject the Jareb-Parker model based on its ability to determine test-eligibility rates within a college.

This study next seeks to determine if there exists a statistically significant difference between the accuracy of the seven methods developed by Jareb and Parker to determine this test-eligibility rate. Of the 45 observations, seven were generated by

"ACT Distribution" schools, and 34 generated by "SAT Distribution" schools. Figure 20 displays a boxplot of the difference between observed and predicted rates, by method. The "SAT Distribution" observations are tightly clustered; the "ACT Distribution" observations appear to come from a population with different variance. Their means are 0.131 and 0.0007, so it is possible that the two methods produce test-eligibility rates of different accuracy. Their standard deviations are 0.22 and 0.11, respectively. Hence, any comparison of sample means must account for unequal sample sizes and unequal variances.

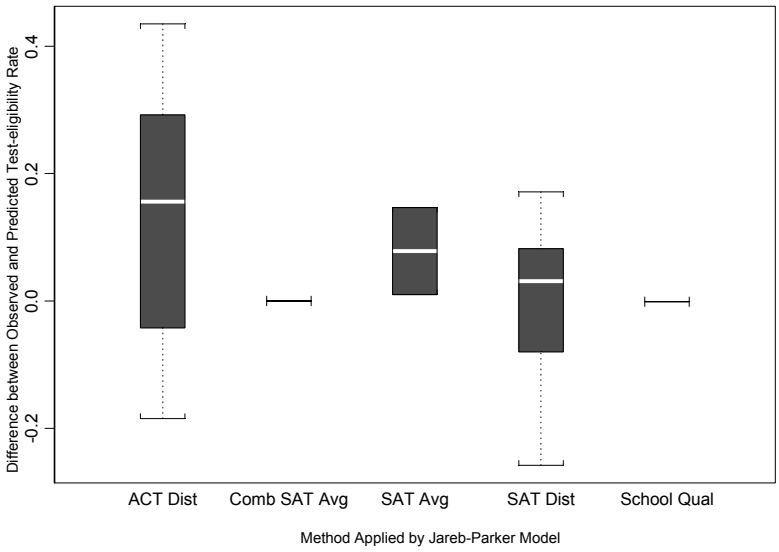


Figure 20. Boxplots of Difference Between Observed and Predicted Test-Eligibility Rates, by Method. (Created by Author)

To determine if this difference is likely due to chance, the samples of test-eligibility rates from "SAT Distribution" and "ACT Distribution" schools were compared using the Welch Modified Two-Sample t-Test. This test, unlike the paired t-test, accepts populations with unequal variances. The null hypothesis states that the true mean of the difference between observed and predicted test-eligibility rates is zero. With seven degrees of freedom, the test found inadequate grounds ($p = 0.168$) to reject the null hypothesis. The two most prevalent methods applied by the model—"SAT Distribution"

and "ACT Distribution"—may indeed perform equally well in measuring the test-score eligibility within a baccalaureate cohort. The test suggests that the observed difference in the means may be due to chance rather than a real difference in their performance.

If one accepts that the sample adequately represents the schools within the Jareb-Parker model database, the Jareb-Parker methodology of counting the test-eligible population appears sound for at least 80 percent of the schools in the database. Noted differences between the validation and model output are presumed to stem from differences in counting the attendance-eligible subset of the baccalaureate cohort.

C. CONCLUSIONS ABOUT THE MODEL'S VALIDITY AND USEFULNESS

Although the study did not validate the Jareb-Parker model, MCRC officials may have confidence in the model's database, assumptions and methods, with a few exceptions. Despite some inadequacies in the sampling methodology, extensive interaction with the community of postsecondary research experts yielded comparable measures of QCP. We are confident that when QCP is aggregated by race, the Jareb-Parker model produces estimates that, on average, are between 5 and 21 percent higher than estimates based on college reporting and the described imputation. It is unlikely that these measures were so similar by coincidence. Three exceptions should be noted.

The use of ACT and SAT standards that are not considered concordant caused confusion among officials at schools that accept both entrance examinations. This disparity presumably causes the observed higher rates of variance in schools whose test-score eligibility rates were based on "ACT Distribution." It probably makes for more difficult recruiting in the 9th, 8th and parts of the 4th District, where the ACT prevails in high school testing. This can be remedied by updating MCRC concordance tables and test-score eligibility criteria.

The model may be inaccurate as far as Black, and some Hispanic, students are concerned. Test-score eligibility standards for Marine officer programs, and within the model, are based on the national distribution of SAT scores. Among 2001 college-bound seniors, 75 percent described themselves as White or Asian-American. As a group, their mean SAT I Verbal and SAT I Math scores run 50 to 140 points higher than comparable scores for Hispanic or Black students (College Board, 2001). Counts based off a

distribution that is so heavily weighed by higher-scoring students will overstate the numbers of the other population groups, and this QCP model appears to suffer from this trait. Black QCP may be overstated by as much as 90 percent. While the model should enable MCRC officials to sufficiently identify the geographic distribution of potentially qualified Black college students, the true quantities of potentially qualified Black students probably cannot be accurately identified using full-time attendance counts and ACT or SAT score summaries. Remedies to this situation are beyond the scope of this effort. The omission of colleges in Puerto Rico presumably causes an understatement, in this case, of Hispanic QCP. This can be remedied by inclusion of Puerto Rican schools in the model.

The static nature of the model makes it subject to error as long-term trends in the college population assert themselves, or when local conditions change rapidly. This can be remedied by expansion of the model with historic data and a forecasting mechanism.

VI. EXPANSION OF THE MODEL

A. STRATIFICATION OF THE DATABASE

The model's database was expanded so that it could display QCP by entry level into each officer program with greater fidelity. The study added 30 schools to the database. Appendix E notes these additions. The study then added 1996–2001 completions and fall enrollment figures for the 1,044 schools in the expanded model. The completions figures allow for forecasting of OCC QCP. The enrollment figures allow for forecasting of PLC QCP by counting full-time enrolled male resident students, by race, at five levels: first-time freshmen, first-time students who are not freshmen, second year, third year, fourth year and beyond.

B. PROPENSITY MEASURES

This section proposes a measure of propensity for a student from a defined college to join the military service, the Marine Corps and a commissioned officer program. The study considered three possible models of propensity.

- Attitudinal Survey Model. This model estimates propensity through analysis of survey responses.
- Characteristic Model. This model estimates propensity through analysis of observable qualities within a geographic entity, such as economic conditions, selectiveness of admissions, etc.
- Historical Model. This model estimates propensity though analysis of historical mission attainment trends within a geographic entity.

Suggestions that college students have a quality known in the recruiting literature as "propensity" pose something of a contradiction. These people entered college or the labor force without committing to ROTC, service academy or reserve duty options presumably available to them. But some quality does, after all, make them stand out from the majority of college students who do not commit to military service. The challenge is to identify these people.

In order to do so, this study considered three different types of propensity measures. It also developed a list of standards against which to gauge the effectiveness

of each potential measure of propensity. A good estimator of propensity should possess the following qualities:

- data exists to support the measure;
- it proves sensitive to changes in the market;
- it is simple; it is easily understood and applied;
- it applies equally well to a geographic entity or an individual college;
- the error structure is understood; and
- its findings correlate to observed behavior of applicants.

A model that meets the preceding criteria should prove useful to recruiting agencies.

1. Attitudinal Model

The attitudinal model proved difficult to develop. This study found no data that would support a comparison between college students and OCC/PLC applicants. UCLA's CIRP measures attitudes among freshmen on an annual basis, and does ask if they intend on entering the military after graduation. Use of this survey was rejected because it apparently lacks an ability to distinguish between respondents interested in USMC OCS programs and respondents interested in other services or programs; the results appear skewed by ROTC participants.

The study then examined the DoD YATS. While this decades-long annual survey project recently ended, it may have gathered enough observations to gauge propensity on a geographic basis throughout the United States. The use of YATS to measure propensity in officer programs has been rejected by other efforts because it excludes dormitory residents. This study attempted to measure the propensity of survey respondents before they might enter dormitories and who later entered the service as commissioned officers.

a. The Data

The DoD YATS was administered every autumn during the years 1975–1999. The survey consisted of nearly 200 questions that sought to measure youth perceptions of the military. The survey was administered by telephone to youth, 16 – 24 years of age. The respondents—about 10,000 each year—were selected by a complex

sampling methodology that excludes dormitory residents but is focused on high school seniors and young members of the labor force.

The data obtained from the YATS consist of two sets of observations. The first set contains 52 responses obtained during the years 1984–1999 from young adults who were later commissioned as officers in the Marine Corps or Navy. These respondents were identified by matching CNA commissioned officer accession records with DMDC survey respondent records. The second set consists of a random sample of 17,230 responses to the survey during the period 1990–1999. The small size of the sample of commissioned officers prevents analysis of propensity within geographic entities, or across time, but appears to give a useful basis for further study.

b. Methodology

Traditional measures of propensity with the YATS rely on the respondents' stated intentions, either prompted or unprompted. Each respondent is asked about his or her plans in the next few years. If the respondent expresses a possibility of entering the service without prompting from the interviewer, the "mention" is considered "unaided." Later in the survey, the interviewer specifically asks if the respondent is considering military service. If so, this is considered an "aided mention." The level of "unaided mention" is considered the strongest standard by which propensity is measured in a population with the YATS.

The YATS also asks about plans for additional schooling. This study used those responses to test the following hypothesis: YATS respondents who were later commissioned in the Navy or Marine Corps could be distinguished from other survey respondents by a combination of strong propensity for additional schooling and an openness towards military service. To test the hypothesis, the survey created four variables from the YATS samples. Table 14 displays these variables, labeled "P1," "P2," "P3" and "P4." Each constructed variable accounts for both a plan to obtain more schooling and an attitude towards future military service. The number of potential constructed variables was limited by the number of survey questions that remained consistent through the years of the program: many promising questions were only used for a portion of the YATS era.

YATS Question Number	Question Wording	P1	P2	P3	P4
V438SCHOL	(unaided mention that respondent plans on more schooling in the next few years/after high school)	True			
V438JOIN	(unaided mention that the respondent plans on joining the military service in the next few years/after high school)	True	True		
Q415	What is the highest grade or year of school/college that you would eventually like to complete?		16 (BA/BS)	16 (BA/BS)	16 (BA/BS)
Q503	Now I would like to ask you how likely it is that you will be serving in the military in the next few years. Would you say...			"Definitely" or "Probably"	"Definitely," "Probably" or "Probably Not"*

Table 14. Constructed Variables for Testing of YATS Hypothesis. (Created by Author)
*Note: Q503 offers four choices: "Definitely," "Probably", "Probably Not" and "Definitely Not." P4 excludes just those respondents firmly opposed to the idea of military service.

c. Analysis

Analysis of the YATS data requires consideration of its dependence on time. Table 15 displays a level of response to three of the survey questions on which the constructed variables for this study depend. The percent response is measured over the sample of 17,282 YATS respondents taken for this study, rather than the entire set of YATS respondents. While the data do fluctuate, it is difficult to discern any trend. This study proceeds under the assumption that the year of survey did not appreciably affect responses to the subjects under discussion, and so each year's sample of respondents may be aggregated and compared.

Of the 52 respondents who later obtained commissions in the naval services, four (7.7 percent) had stated that they would definitely serve in the next few years, and seven (13 percent) had offered an unaided mention that they might join the

military. Those response rates alone greatly exceed the rates observed in the population as a whole. Remarkable, though, is the fact that 79 percent of these 52 officers expressed little interest in military service near the end of their high school experience. Such findings suggest that the decision to seek a commission occurs in college or afterwards for a majority of officer applicants, but that it may also be productive to use attitudinal survey to identify regions with higher densities of high school students interested in officer commissions.

School Year	Unaided Mention to Join	Definitely Will Serve in Next Few Years	Would Like to Earn a Bachelor's Degree
90-91	3.67%	1.85%	33.86%
91-92	4.48%	1.92%	34.59%
92-93	3.32%	1.31%	26.63%
94-95	3.91%	1.66%	26.45%
95-96	5.39%	2.16%	28.01%
96-97	4.63%	1.86%	26.69%
97-98	5.13%	1.35%	27.13%
98-99	4.41%	1.60%	26.86%
Mean	4.47%	1.73%	28.54%

Table 15. Percent Response to Selected YATS Questions in Sample of 17,282 Respondents, 1990–1998. (Created by Author)

The analysis thus finds that by any of the four constructed measures of propensity, these 52 respondents stand out from the population as a whole. Table 16 compares the percent of responses observed in the two samples under consideration.

Sample	P1	P2	P3	P4
Commissioned (52 respondents)	5.77%	3.85%	19.23%	28.85%
Not Commissioned (17,230 respondents)	0.77%	1.57%	4.14%	13.48%

Table 16. Percent of Positive Responses to Propensity Variables Constructed from YATS Data 1990–1999. (Created by Author)

d. Conclusions

When compared against the measures of effectiveness developed for this study, the use of an attitudinal survey is rejected in favor of the historical model, below. The small sample size, possible dependencies in the data and need for an arguable assumption makes the former less desirable. The results of this brief analysis of YATS responses suggest, though, that current attitudinal survey efforts by MCRC in support of enlisted recruiting efforts might be expanded to forecast propensity to enter the OCC or PLC programs among college-bound youth.

2. Characteristic Model

To develop a model of propensity that relies on measurable characteristics found at colleges, this study incorporated questions about observed propensity in the OSO Census. During the resurvey phase of this census effort, several experienced officer recruiters considered it highly unlikely that any means could be developed to predict college student willingness to enter officer commissioning programs. There exist, however, certain characteristics within colleges and student populations that permit recruiting districts to prioritize their assigned schools, or that lead officer recruiters to focus their efforts. OSO training observed by this survey, for instance, suggested that officer recruiters focus their efforts at liberal arts colleges within large state universities, or at meetings of ethnically oriented societies for engineers.

Respondents to the OSO Census ranked the characteristics listed in Table 17, in order of precedence, as the most common characteristics that distinguish "new working applicants" from their student populations. Each choice was selected by at least twenty percent of census respondents.

This study failed to obtain a set of data that would enable analysis of students or colleges based on the characteristics listed in Table 17. Hence, a characteristics-based model is not discussed further.

Characteristic	Percent of Respondents who Indicated that Characteristic was Important
Family member served	58
Participation in certain clubs	41
Prior enlisted service	37
Current service in reserves/national guard	37
Grew up in middle-class family	33
Participation in student leadership	30
Lives on campus	29
Member of fraternity/sorority	24
Liberal arts major	20

Table 17. Characteristics Identified by OSO Census Respondents as Differentiating New Working Applicants from Student Body. (Created by Author)

3. Historical Model

To develop a historical model of propensity, this study considered the use of historical rates of mission attainment by recruiting station or the use of data on applications that were initiated, rather than completed. This data was not available, so the study looked to the records of completed applications contained in the Automated Recruit Management System (ARMS) database.

a. The Data

The ARMS database contains 114 fields of information on nearly 15,000 applicants to the OCC and PLC programs over the past decade. Because this propensity measure focuses on the college population, records of prior service applicants and records without a valid college code were removed. Records for applicants prior to 1995 were also excluded because some fields deemed relevant to the propensity measure during those years were empty. When implausible values were also removed, 7,063 (47 percent) remained. Data from other sources—IPEDS, the Carnegie Foundation, Barron's and the Jareb-Parker model—was appended to describe the environment from which these applicants came. To reduce the effect of missing values, several quartile and dummy variables were derived. Appendix G presents the fields that were considered for inclusion into a model of propensity. The records span the period between April 1994 and July 2001.

b. Methodology

Applicants who express interest in Marine officer commissioning programs must first demonstrate to the OSO that they meet the program's requirements. During this phase, the student is known in recruiting lingo as a "new working applicant." Once the "new working applicant" is known to meet eligibility requirements, he or she formally enters the program through a contract. Around the time of contract signing, the applicant also agrees to an OCS report date. Record of this contract signing and "scheduled ship date" provide the earliest mention of an applicant within the ARMS data obtained for this study. (MCRC, 1989)

This study hypothesizes that the time difference between the signing of the contract and the scheduled report date to OCS demonstrates a degree of propensity. Students with a strong interest in service as a Marine officer presumably initiate and complete the application process sooner than students who are uncertain about their first job after college. An unpublished study conducted at OCS during the early 1990s suggested that success at OCS is correlated with the number of months between this commitment and report date. Candidates who signed a contract five or six months before reporting were more likely to succeed than candidates who signed their contract only a month or two prior. Two factors may cause that higher success rate. The candidate who agrees to attend OCS six months out has more time to prepare, physically and mentally, than the candidate who agrees to attend OCS only two months out. But it may also indicate the presence of propensity to join among those who sign their contracts earlier, for they are less ambivalent about their future and more motivated to overcome difficulties encountered at OCS and while waiting to be eligible for commissioning. This research hypothesizes that propensity to commission may thus be estimated. Longer periods of time between contract date and scheduled ship date (known hereafter as "delay") indicate higher levels of propensity.

Any analysis of this data must contend with its dependence on time. This correlation of delay and time may invalidate comparisons using statistical methods that rely upon an assumption of independence, for findings made during 2002 may not apply to later years. Accordingly, this survey compared the data in a manner that may prove

robust to serial dependency. Hand *et al*. (2001) describe an approach known as *feature extraction*, in which the many dependent observations are reduced to one or two variables free from dependency. To reduce serial dependency, the study uses an ordinal ranking system. The many observations of delay are reduced into a median delay time, by US Census Bureau geographic entity, for each OCC and PLC (Combined) course for which there appeared a complete set of observations. (US Census Bureau Regions are listed in Appendix H, under "Geographic Region.") The geographic entities are then ranked according to the order in which they met 50 percent of their goal for a given year. If the applicants from any one geographic entity show significant propensity or adversity to military service, this study expects it to appear as a consistently high or low ranking against the other entities.

The research applies classification and regression tree techniques to examine the hypothesis. An agglomerative nesting technique then yields a geographic structure within a measure of propensity.

The classification tree is a modeling technique that allows exploration of structure within a dataset. These trees offer a form of discriminant analysis suitable for datasets containing mixed continuous and categorical variables (Venables and Ripley, 1994). The classification tree algorithm begins with a categorical response variable y_i— in this case, "drop type": a factor indicating that a record contains evidence that the applicant was commissioned, was found not physically qualified, or was either found unsatisfactory or dropped on his or her own request. This evidence comes in the form of an OCS or MCRC "drop code," which indicates a candidate who was injured, who withdrew from the program, or who was removed from the program for cause. The algorithm then receives a matrix of predictor variables that it uses to classify the records. Factors considered in this study are listed in Appendix G.

The classification tree algorithm selects the explanatory variable with the strongest ability to distinguish between those applicants who did and did not drop out of the program. The subset, or node, is split into two smaller nodes. After this initial partition, the technique examines each resultant node of the data and continues to split these subsets. The end result is a tree-shaped structure in which the "leaves" consist of

subsets of applicants with a high or low proportion of drops. It was hypothesized that this technique may identify characteristics among applicants that may suggest a stronger motivation to prepare for OCS, endure injuries, perform well at OCS and see the program through to a commission.

When analyzing continuous variables x_j, such as "delay," the algorithm chooses a value t such that $x_j < t$ and $x_j \geq t$ best discriminates between classes of y_i. The method splits categorical variables, such as "Number of Waivers" along the same type. Multiple divisions of a node are prohibited. The algorithm classifies the y_i without regard for missing values, so y_i with missing values remain in nodes until the algorithm finds adequate information in its other explanatory variables to place the observation into a leaf. Small changes in the data can produce different trees. (Venables and Ripley, 1994)

The process of partitioning continues until each leaf has fewer than five members. Now, a tree based on a dataset of over 6,000 observations could produce 1,200 five-observation leaves. Such a tree would be difficult to comprehend, though it could have a good ability to classify new observations. A method has thus been developed to "prune" large trees into structures that are more readily understood. This method balances the qualitative value and misclassification rate of the model to produce a tree that provides an acceptable compromise between classification ability and utility. It begins by computing the "deviance" of all possible sizes of trees. Deviance is defined as the sum over all leaves of the –2 log (likelihood that observations *i* are members of class *k*) (Venables and Ripley, 1994). The analyst then examines smaller trees that demonstrate low deviance to find one that is both simple to understand and accurate enough for the purpose at hand. This study sought to develop a tree that would use factors listed in Appendix G to classify applicants by their likelihood to commission, be injured or drop for cause. Such a tree would identify important factors in an applicants' unpreparedness or unwillingness to complete the program, signs of possibly lower propensity to join than those who succeed.

Regression trees operate in a manner similar to classification trees. Instead of a categorical response variable, this form of tree applies a piecewise constant model to a continuous response variable, which in this case was "delay." The regression

algorithm splits the continuous variable at the point that yields the purest partition of the explanatory variables. The algorithm measures the success of its splits with the same measure of "deviance" as used by the classification tree algorithm. The resulting tree is then pruned to an understandable size while holding deviance to an acceptable value.

Once satisfied that "delay" may indeed measure propensity, agglomerative nesting is applied to the median value of delay among all applicants within geographic entities. Agglomerative nesting provides a method of clustering observations by a measure of their similarity. It operates on a hierarchical level, in that it starts with a single observation, then builds clusters beginning with the average nearest neighbor as measured by Euclidian (root of the sum of squares of differences) or Manhattan (sum of absolute differences) distance. The process ends with a suggested number of clusters within the dataset. This study applied agglomerative nesting to identify geographic clusters of propensity within the college population.

c. Analysis

The analysis begins with an examination of the delay variable's behavior over time. When viewed as a time series, the variable displays nonstationary behavior. Figure 21 plots the mean delay for each fiscal year, for each of the three officer commissioning programs and by each of the four commissioning components. Each point on the plot represents the mean value of "delay" for a given year and program or component. The plots suggest that the variable is subject to trends over time. Through the late 1990s, the data reflect a downward trend, perhaps reflecting the reports of a more difficult market by recruiters in this era of a strong commercial need for skilled labor, closure of many supporting facilities and reduction of medical personnel assigned to the recruiting force. After 1999, an upward trend appears in some cases.

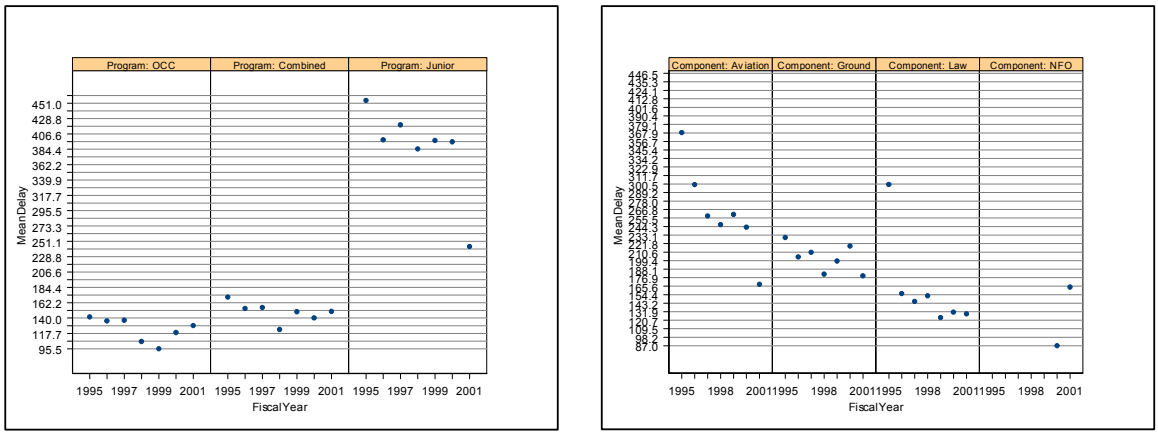


Figure 21. Mean Days Between Contract and Scheduled Ship Date for USMC Officer Programs and Components, 1995–2001. (Created by Author)

The program plot also illustrates a problem with the data. PLC Junior mean "delay" figures exceed OCC and PLC Combined means by about a year. This disparity is not natural; it appears due to overwriting of the PLC Junior scheduled ship dates entered into the database. When an applicant applies to the PLC Junior program during freshman or sophomore year, the applicant agrees to attend two six-week courses over the next two or three summers. The scheduled ship date recorded in ARMS reflects a report date to the Junior course until a candidate successfully completes it; the date is then overwritten to reflect the candidates scheduled date to report to the PLC Senior course a year later. Thus, the mean FY2001 PLC Junior delay time is significantly lower than that of preceding years because it reflects applicants waiting to attend the Junior course rather than applicants with an additional year or two added to the original report date. The PLC Junior delay times are also presumably skewed by the conduct of two consecutive courses each summer. Some candidates can choose between two courses offered during any given summer, whereas some have no choice. Students at schools with a quarter rather than semester schedule complete their classes too late to attend the earlier summer course, so the delay variable for PLC Junior/Senior program exhibits a dependency on college schedule. Unfortunately, this study did not find any information within ARMS that indicates which course a candidate attended before the original scheduled report date was overwritten. Hence, delay time cannot be analyzed for

propensity to enter the PLC Junior program with available data. The study does not further consider PLC Junior data.

When the means are considered by component, as in Figure 21, there appears a basis for this method of using delay time to estimate propensity for the other programs. The plot shows that aviation component applicants consistently sign their contracts earlier than either ground or law applicants, with law component applicants proving the last, as a group, to sign. The NFO component is new. This ordering of components, by delay time, follows the ordering reported by officer recruiters. With the exception of the 9th District (located in the Upper Midwest), respondents to the OSO Census consistently rated the Law components as the most difficult to fill during FY01. During FY02, OSOs in two districts felt the NFO goal was harder to meet than Law; in no cases did OSOs during either year feel that Ground component goals were the hardest to meet. Generally, OSOs reported that the aviation component was the next most difficult mission, so intuitively, that component would return shorter mean delays than the ground component (which Figure 21 shows is clearly not the case). The higher aviation component mean delay times appear to reflect aviation applicants whose medical processing took too long to ship them during the year of application. Such applicants are "carried over" to the beginning of the following fiscal year, hence influencing the mean to behave in an unintuitive manner.

This unintuitive behavior of the mean aviation component delay time does reflect one valid criticism of this propensity measure: it is somewhat dependent on the ability of OSOs to get their new working applicants qualified to sign the contract. But as the hypothesis suggests, this study finds support for this measure among reports from officer recruiters. The OSO Census asked respondents to indicate reasons that "new working applicants" quit the application process before they sign the contract. Respondents report that "new working applicants" to the Law program quit most often because they either prefer commercial opportunities or do not believe they can cover their college tuition debts with a Marine Corps salary. "Prefer Commercial Opportunity" was the second most selected reason that "new working applicants" to the Ground program quit. If one takes "Prefer Commercial Opportunity" as an indicator of low propensity,

then the census respondents find this quality highest in Law, then Ground, applicants (as Figure 21 suggests). OSOs found that eligibility-related excuses for quitting among new working Law and Ground applicants were generally less common than propensity-related excuses. For instance, the third and fourth reasons that new Law applicants reportedly quit before contracting are because they either cannot meet physical fitness standards or they cannot meet test-score eligibility requirements. Meanwhile, of the four reported reasons applicants to the aviation programs quit before contracting, three are related to eligibility rather than propensity: failure of the aviation aptitude test, failure of physical fitness standards and medical disqualification. Not until one reaches the fourth most popular reason—applicants lose patience with the application process—does one find support for a propensity-related excuse for aviation applicants to quit the process.

Hence, the use of delay time incurs some error. Regardless, if a school or region contains a higher proportion of students with propensity to enter the OCC or PLC program, then it follows that qualified people will present themselves at a higher rate than in areas with low propensity. This study did not encounter any evidence suggesting that students with exceptional levels of physical fitness, aptitude for flight, or aptitude for law practice are more common in the set of students that show no interest in the military.

Any analysis of the delay variable also must contend with autocorrelation. OCS classes convene four times per year. Recruiters thus sign contracts on a cyclical basis as they work to fill these courses. The program also allows for applicants to sign contracts two fiscal years before their report date. Figure 22 plots the contract dates as a time series, by program. The plot indicates that the contract dates correlate on a monthly or almost weekly basis throughout a given year. It is clear that any inference of an expected value, across time, will produce a correlated error structure. Each diagonal striation in the scatter plot illustrates the progress of recruiters around the country filling up goals for future OCS courses. The PLC Junior program operates two courses per summer; hence the plot shows a cluster of two diagonals per year. PLC Combined only meets once per year, hence the relative sparseness of the points compared to OCC, which meets thrice per year. The data also reveal that observations about applicants to the earliest and latest courses within the time span are incomplete.

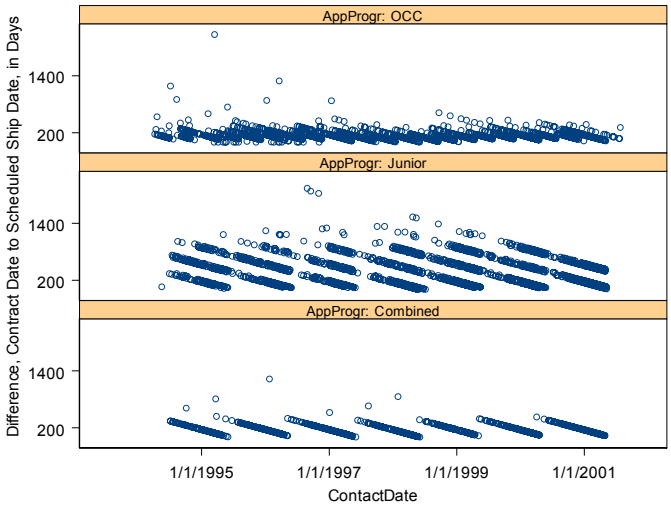


Figure 22. Contract Dates over Time for Officer Programs, 1995–2001. (Created by Author)

This study removes the incomplete courses from the data set, and then ranks each region, each year, by its median delay time. The rankings are plotted in Figures 23 and 24, with accompanying Tables 18 and 19.

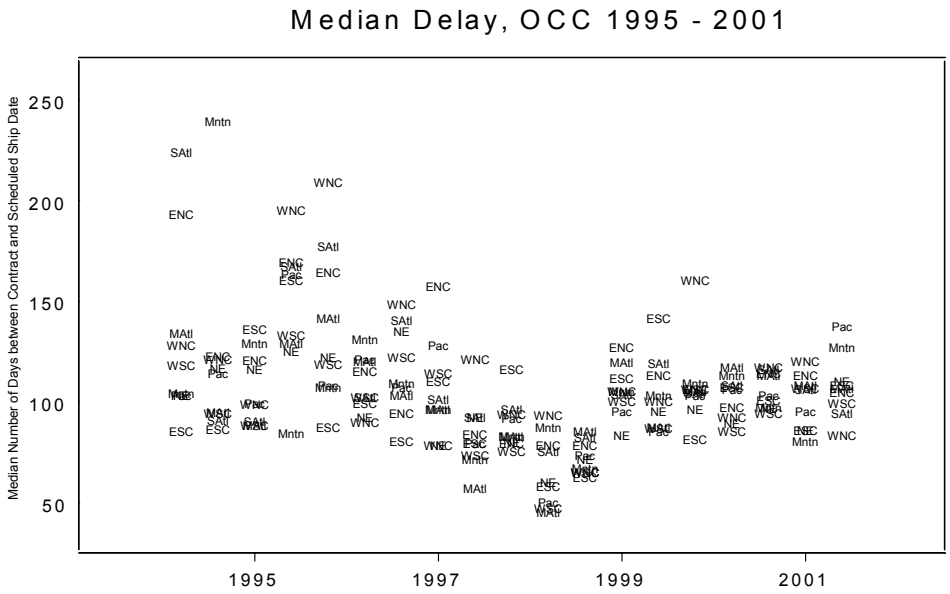


Figure 23. Median Days Between OCC Contract and Scheduled Ship Date, by US Census Bureau Region 1995–2001. (Created by Author)

	OCC Course																	
Census Bureau Region	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176
New England	7	4	5	6	7	7	1	3	1	5	9	7	8	4	8	6	2	7
Mid Atlantic	4	7	9	9	5	3	6	8	9	6	2	2	5	6	4	1	1	3
South Atlantic	1	8	7	4	2	1	3	6	5	8	6	3	2	1	6	3	6	4
East North Central	2	3	4	2	3	5	4	1	3	7	1	1	1	3	2	2	5	2
East South Central	9	9	1	5	8	6	9	4	6	2	4	9	6	1	9	7	8	8
West North Central	3	2	8	1	1	8	2	9	2	4	5	8	3	5	1	5	4	5
West South Central	5	6	3	7	4	4	5	5	7	9	8	6	7	8	3	8	7	1
Mountain	8	1	2	8	5	6	8	7	8	3	3	4	4	2	5	6	6	9
Pacific	6	5	6	3	6	2	7	2	4	1	7	5	6	7	7	4	3	6

Table 18. Rankings of Census Bureau Region by Median Days Between OCC Contract and Scheduled Ship Date, 1995–2001. (Created by Author)
(A ranking of 1 indicates the first region, during a given class, to meet 50 percent of its OCC officer recruiting goal)

Both figures reflect the downward trend through 1999, then the apparent upward trend that was mentioned previously. But, the ordinal relationship between the regions is not dependent on the date of observation, as they are now categorized by complete sets of observations for any given OCS class. If, as suggested by the related literature on officer recruiting, there exist regional differences in propensity to enter Marine officer commissioning programs, one expects the differences to show in these figures and tables as fairly consistent rankings. Variation in rankings from year to year is also expected, reflecting actions aimed at boosting contract writing in under-performing areas (assuming MCRC officials could identify the reasons behind poor contract writing and could effectively place additional resources against them). The figures and tables show some consistency among the performance by regions. Within the PLC Combined rankings, for instance, the Mid-Atlantic Region ranks last or second-to-last in all but one year of observation. This study hypothesizes that this nonrandom appearance suggests the presence of factors that affect the delay observed between regions. One factor may be

differing abilities or policies between recruiting districts. The boundaries of geographic region and recruiting district differ, but in some cases, such as the Pacific Region, the region is completely nested inside the recruiting district. And during the seven years of observation, all active duty recruiting personnel within these districts surely changed. So, district policies and abilities do not appear to explain all of the behavior of these rankings. The boundary between the 4th and 6th Recruiting Districts, for instance, splits the South Atlantic Region, but the South Atlantic Region, with two exceptions, appears near the top of the rankings.

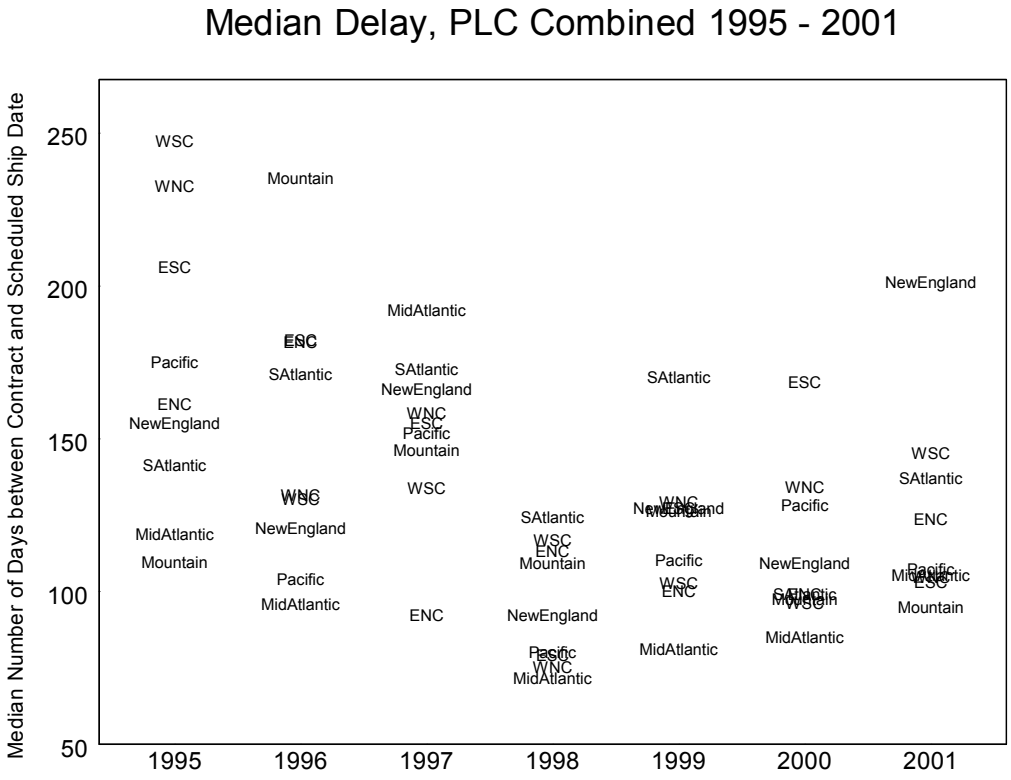


Figure 24. Median Days Between PLC Combined Contract and Scheduled Ship Date, by US Census Bureau Region, 1995–2001. (Created by author)

	Summer of PLC Combined Course						
Census Bureau Region	1995	1996	1997	1998	1999	2000	2001
New England	6	7	3	5	3	4	1
Mid Atlantic	8	9	1	9	8	8	6
South Atlantic	7	5	2	1	1	5	3
East North Central	5	3	9	3	7	5	4
East South Central	3	2	5	7	3	1	7
West North Central	2	6	4	8	2	2	6
West South Central	1	6	8	2	6	7	2
Mountain	9	1	7	4	4	6	8
Pacific	4	8	6	6	5	3	5

Table 19. Rankings of Census Bureau Region by Median Days Between PLC Combined Contract and Scheduled Ship Date, 1995–2001. (Created by Author)
(A ranking of 1 indicates the first region, during a given year, to meet 50 percent of its PLC Combined officer recruiting goal)

The OCC data, however, exhibit two qualities that render it unsuitable by the established measures of effectiveness. First, OCC classes are comprised of applicants recruited both from colleges and from the labor force. Results from the OSO Census suggest that different forces motivate these two groups. OCC applicants appear less enamored by commercial opportunity (in fact, applicants from the labor force are rejecting commercial opportunity) and are more motivated by inability to find employment in their chosen career field. As this study seeks a measure of propensity in colleges only, use of OCC delay times may not be an appropriate measure. Also, the number of OCC candidates needed during any given year depends somewhat on the success of the PLC program. Hence, years with high attrition from PLC courses or the PLC "pool" will generate more observations of OCC delay. For these two reasons, the study does not further consider OCC data. The study bases its measure of propensity upon observations obtained from applicants to the PLC Combined program only.

The ordinal ranking of Census Bureau regions, by PLC Combined delay times, is now compared over observations obtained for seven OCS classes between the years 1995 and 2001. Figure 25 permits comparison of the regions by this measure. Some regions appear to approach different centers than others. Distributions of the mean and median delay times and ranks appear nonnormal.

So to quantify the difference in center among the nine regions, this study applies the Kruskal-Wallis rank sum test of K populations (also named the "H-test") to the mean and median delay times, grouped by j regions. This test supports assumptions of nonnormal distributions, though it lacks the power of parametric measures such as ANOVA. To compare the $N = 9$ samples, they are ordered by increasing size, R representing the rank of each observation. Equivalent observations are handled by taking the mean of the ranks of these observations. A test statistic, H, results:

$$H = \left\{ \frac{12}{N(N+1)} \sum_{j=1}^{K} \frac{R_j^2}{n_j} \right\} - 3(N+1) \tag{6.2}$$

The expression in Equation 6.2 has been shown to follow a χ^2-distribution with $K - 1$ degrees of freedom if the null hypothesis of equal expected values is true. (Kanji, 1999)

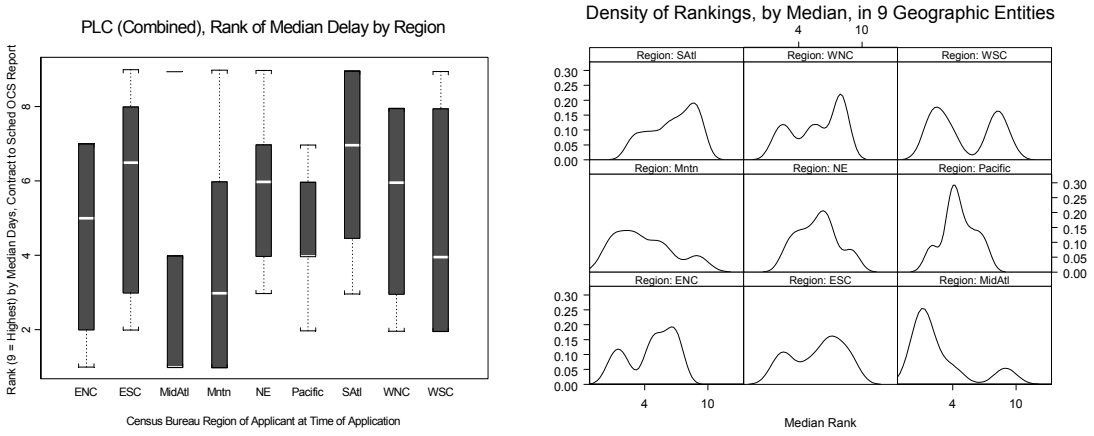


Figure 25. Distribution of the Ranking of Geographic Regions by Median Days Between Contract and Scheduled Ship Date, PLC Combined, 1995–2001. (Created by Author)

The null hypothesis states that the mean median delay time is equal in every region. At 8 degrees of freedom, the test found insufficient evidence to reject the null hypothesis. With only seven years of observation, the variance by region is too great to support a statistical finding of delay difference at this level. Visually, though, some areas appear to have different centers. The South Atlantic, Pacific and Mid-Atlantic, for

instance, show a tendency to peak at the high, middle and low ends of the range of rankings, respectively.

The study next agglomerated the regions by their median PLC Combined ranking, by median delay per year, over the seven-year period, to determine if this would produce a more significant partition of the propensity measure. This process suggested three clusters of regions. Figure 26 plots the clustering. It shows that the nesting algorithm found one region—the Mid-Atlantic—to be significantly different than the other regions. These three clusters may be thought of as tiers. This study proposes that these regional tiers may serve to estimate propensity among college students. At the top tier are schools located in the South, New England and Upper Midwest. The middle tier consists of schools within the West and Midwest. Mid-Atlantic states occupy the lowest tier.

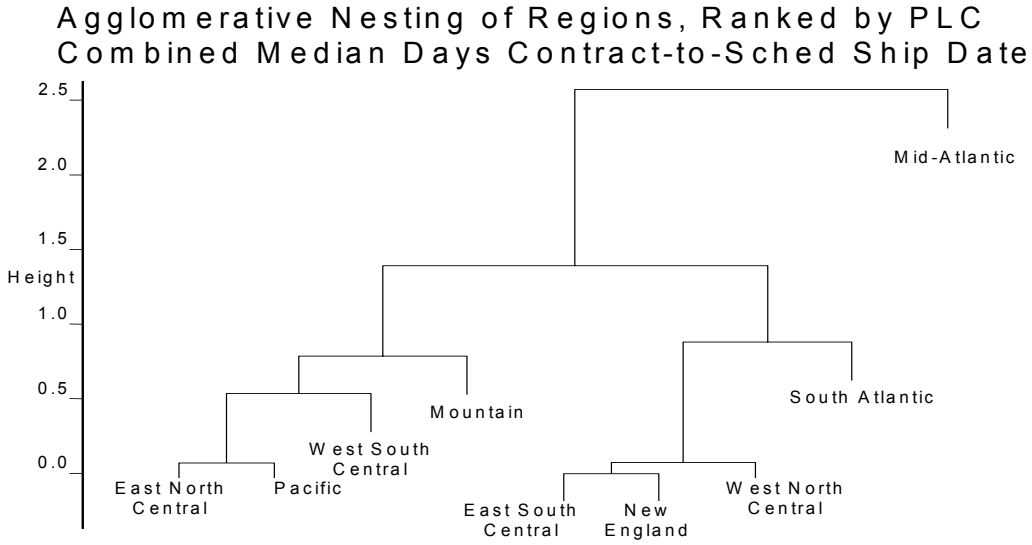


Figure 26. Geographic Regions, Clustered by Similarity of their Rankings by PLC Combined Median Days Between Contract and Scheduled Ship Date, 1995–2001. (Created by Author)

This clustering appears to improve the ability to discriminate between geographic areas of different propensity. Figure 27 plots the distribution of rankings by the three tiers. Clustering brought out the difference between the central tendencies of the distributions. When the Kruskal-Wallis test is applied to the three tiers, the test statistic H = 10.172 is significant (p = 0.007) at 2 degrees of freedom, though one must take into account the fact that the variables were constructed after nesting suggested their presence. This research offers a statistically significant measure of propensity on a regional basis.

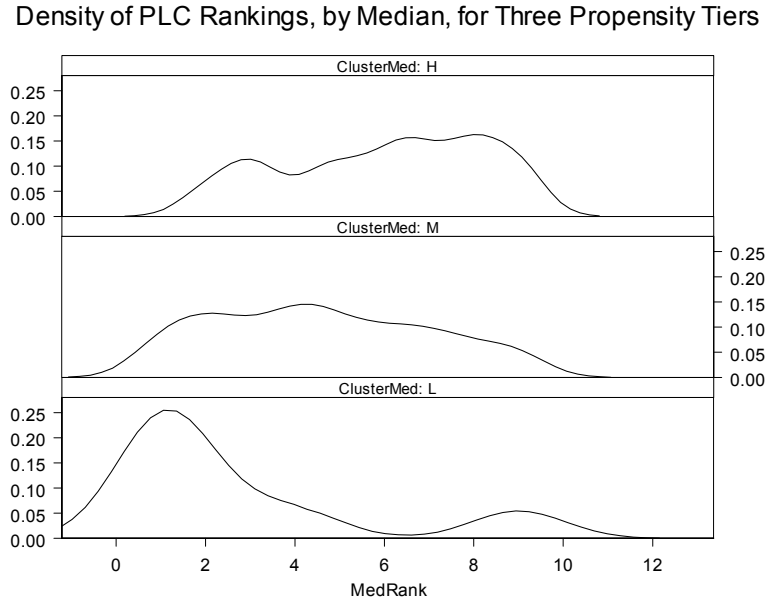


Figure 27. Density of Rankings, within Propensity Tiers, by Median Days Contract Date to Scheduled Ship Date, PLC Combined, 1995–2001. (Created by Author)

In some cases, the results appear to contradict the intuition of recruiters. New England is not traditionally associated with the South in terms of propensity, for instance. The inclusion of New England in the top tier may reflect the influence of a single military-oriented college, Norwich University, origin of five percent of New England PLC Combined applicants. The inclusion of the Mid-Atlantic States in the lowest tier may also be explained. Pennsylvania State University at University Park produced nine percent of commissions from this region. No other school in the region produced more than four percent of the mission. Of the 100 most productive schools,

only five are located in this region. While the region is smaller than the South Atlantic, Pacific or East North Central, ARMS and OSO Census data indicate that the OSOs in this region must work as many colleges to find applicants, suggesting that this region—unlike the others—does not afford a comparable number of large, "propensed" student bodies. MCRC officials may decide if these low delay numbers in the Mid-Atlantic Region show that even the larger state universities in this region have low propensity, requiring OSOs to visit a greater number of smaller schools than in other regions, or if low delay numbers reflect difficulty in rounding up a propensed but more dispersed group of applicants for testing.

Regression and clustering techniques tend to support this propensity measure. This study explored the structure of the data set from the aspect of delay time, using regression tree modeling. An insightful tree was formed when log (delay time) was modeled by Approved Program + Activity Recruited From + Barron's Ranking + Source Recruited From + College Control + College Carnegie Classification + District + Drop + HasMoral + NumWaiv + HasWaiv + Sex + Race + Marital Status. The values of delay time were transformed by the natural logarithm function in order to improve the diagnostics of the model. Figure 28 displays the resulting tree. The text above each node notes the factor on which the algorithm split. Records with the value shown in the text travel left from the split. Each leaf collects records that display a high proportion of the factors labeled along the path from the top of the tree. The plot also displays the mean delay time for observations within the leaf, transformed by the natural logarithm function ("yval"). Underneath this value is shown the number of observations within the leaf ("n").

The tree algorithm finds that delay times are shortest in the districts of New England, the Upper Midwest and West Coast ("District: 01, 09, 12") with female applicants from less competitive schools ("Barrons: COMPETITIVE, NONRATED"). OSO Census respondents were unanimous in stating that female PLC applicants were more difficult to recruit. The tree suggests that the highest propensity exists in applicants from the other districts, who present themselves to the OSO rather than wait to be referred by college placement officials (i.e., those with "Activity Recruited From" other

than “Activity: CP, DT”) and who are recruited by telephone calls, area canvass and office traffic. The inclusion of New England in the lowest tier contradicts the findings of the agglomerative nesting. Again, this contradiction is perhaps explained by the presence of Norwich University amidst an otherwise difficult recruiting market. The nesting algorithm could be more influenced than the tree algorithm by the high values of “delay” from Norwich records. The nesting algorithm measures a difference in “delay” between regions, while the tree algorithm may downplay these differences as it balances the competing needs of “pure” leaves with simple structure.

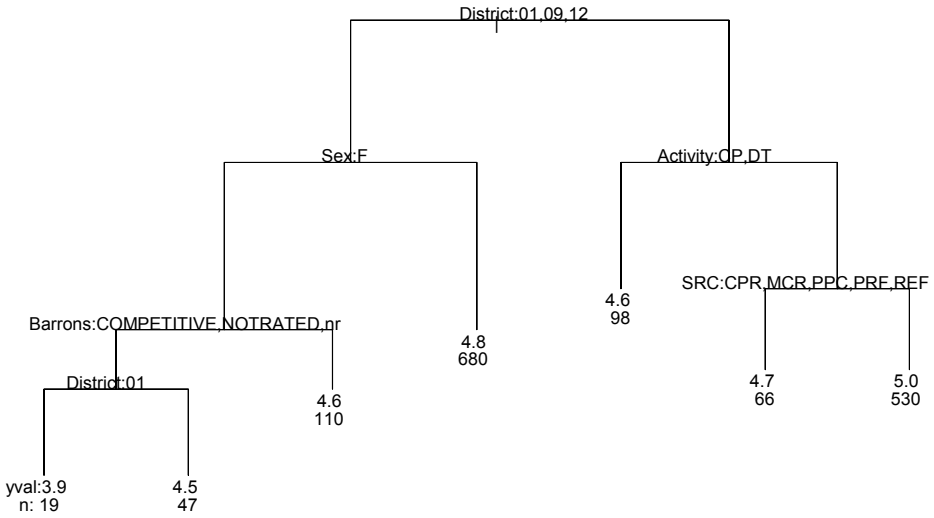


Figure 28. Regression Tree on Delay Times with Individual and College Factors, PLC Combined Applicants 1995–2001. (Created by Author)

When individual characteristics and recruiting districts are removed from the model, the regression shown in Figure 29 is formed. The lowest propensity is found among students located in the Middle Atlantic States, at the schools rated lowest and highest by Barron’s (“GRP: COMPETITIVE, MOST COMPETITIVE, NOT RATED”). The algorithm places 100 applicants in this leaf with lowest propensity; these applicants, on average, signed their contracts only 90 (the natural logarithm of 90 is 4.5) days from their scheduled ship date. The highest propensity is found among students located in the

Southern states, and who tend to present themselves to the OSO rather than wait to be referred by others. The algorithm places 450 applicants in this leaf; these applicants, on average, signed their contracts 148 days (the natural logarithm of 148 is 5.0) from their scheduled ship date. This ordering roughly agrees with the agglomerative nesting.

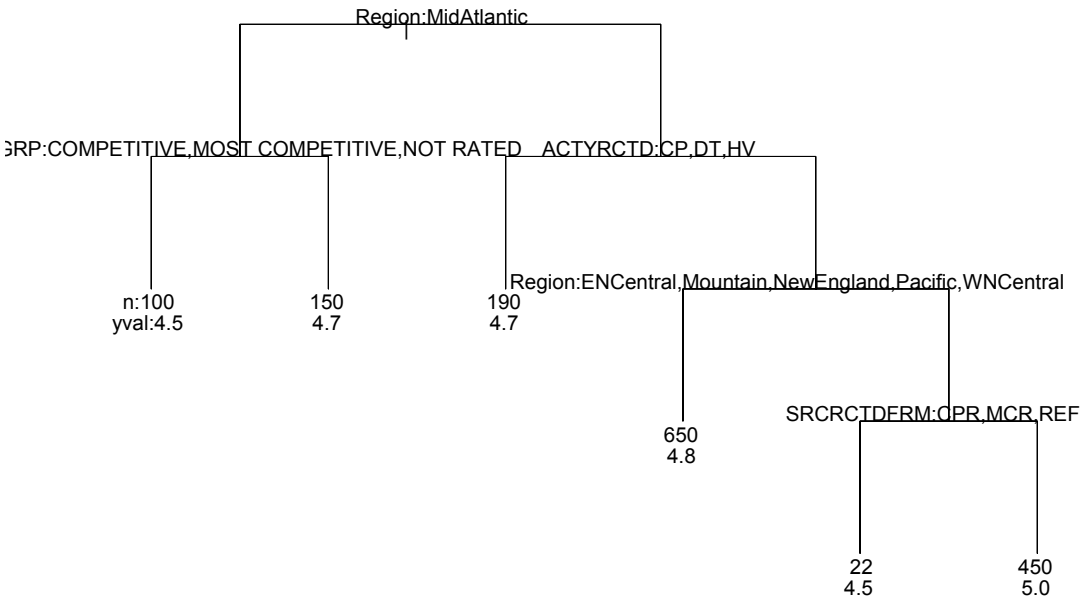


Figure 29. Regression Tree on Delay Times without Individual Factors, PLC Combined Applicants, 1995–2001. (Created by Author)

Finally, when one considers the delay times of those who fail to see their contract through to a commission, stark differences emerge. The median delay time for PLC Combined applicants who succeed exceeds the median time for failed applicants by over a month: 130 days against 108. Figure 30 displays a classification tree in which DropType is modeled by Control + Carnegie Classification + Barron's Rating + Sex + District + Race + Delay + HasWaiver + HasMoralWaiver + NumberofWaivers + HasPhysicalWaiver + ActivityRecruitedFrom + SourceRecruitedFrom + QuartileGPA + QuartilePFT + SATTQuartile. It has a fairly high misclassification rate of 53 percent,

indicating that the model has difficulty distinguishing between the different drop types based on the predictor variables. A naive model that states that everyone drops out would misclassify 54 percent of applicants, so the classification tree gives us little quantitative improvement. However, the splits chosen by the algorithm are illustrative and concur with previously mentioned findings from the OSO Census.

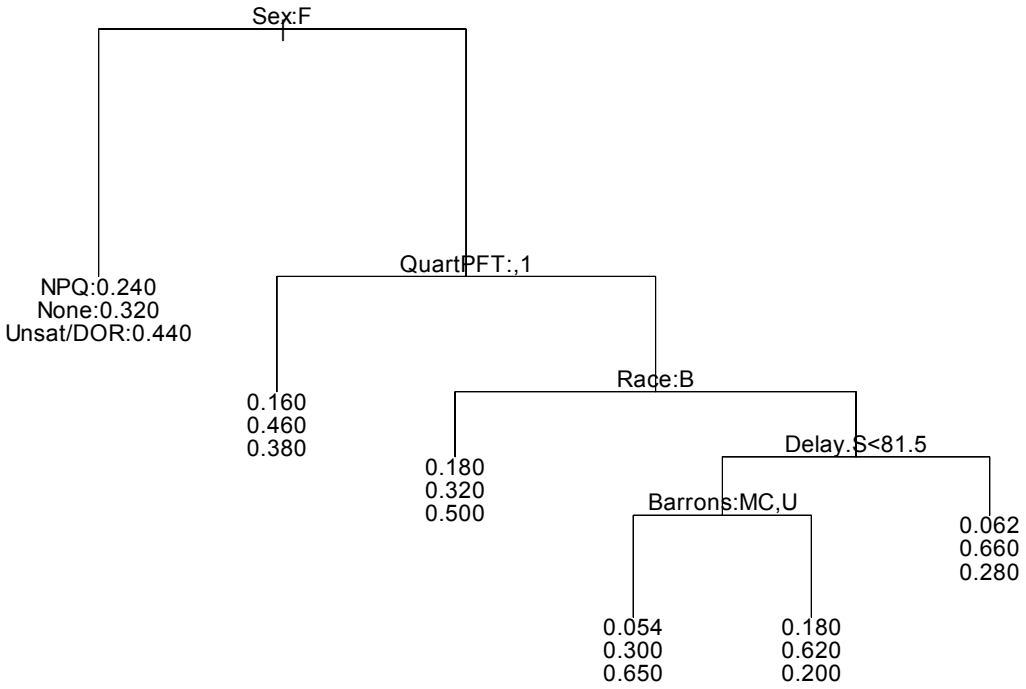


Figure 30. Classification Tree on Type of Drop (NPQ, No Drop ("None") or Unsat/DOR), PLC Combined Applicants 1995–2001. (Created by Author)

The tree suggests that given the explanatory variables, the highest degree of unsatisfactory performance and DOR ("Unsat/DOR" = 0.650) among PLC Combined applicants is found among those who are male, are physically fit, are not Black, sign their contract *less than* eleven weeks away from their scheduled ship date, and attend the Most Competitive schools. Those with the highest degree of success among PLC Combined applicants ("None" = 0.660) tend to differ from the least successful only by delay time; they sign their contracts *at least* eleven weeks away from their scheduled ship date. So,

while other variables appear to affect the willingness and ability to meet the contract obligation, delay time is apparently one of them.

C. FORECASTS OF QCP

The study concluded by forecasting QCP for every school in the expanded model database. This chapter describes the time series nature of QCP and the methodology applied to generate the forecasts.

1. The Data

Selection of a forecasting technique is dependant on the behavior of the data and on the type of forecast required. IPEDS provides ample annual time series data to support quantitative methods of forecasting. To uphold the forecasts, it must be assumed that trends observed in any school's population will continue during the three-year time span through which the study forecasts.

Inspection of 1992–2001 IPEDS completions figures suggests that most college baccalaureate cohorts display trends, with irregular fluctuations. There appear no cycles or seasonality, though between series one expects to find seasonal fluctuation caused by quarterly groups of transfers and graduates, with slow declines due to dropouts in between.

The study seeks to develop a point forecast for each combination of program (PLC Junior, PLC Combined and OCC), MCRC ethnic group (White, Black, Hispanic, Other), academic year (2001, 2002, 2003, 2004) and college (1,044 members of the model database). Thus, the resulting database contains 50,112 point forecasts. A forecast is required for 2001 because IPEDS counts of this cohort have not been released.

To illustrate the behavior of baccalaureate cohort size, Figure 31 displays the time series of male completions counts for five selected colleges. The data is derived from IPEDS. Two of the colleges—Abilene Christian University and Alabama State University—suggest a trend that might be modeled with a quadratic equation. Adelphi University and Adrian College appear to show a linear, downward trend. Some of the mean values change with time; hence the behavior observed with some of these colleges is nonstationary. This wide range of time series behavior runs throughout the database. Overall, completions in 55 percent of the modeled schools declined through this decade.

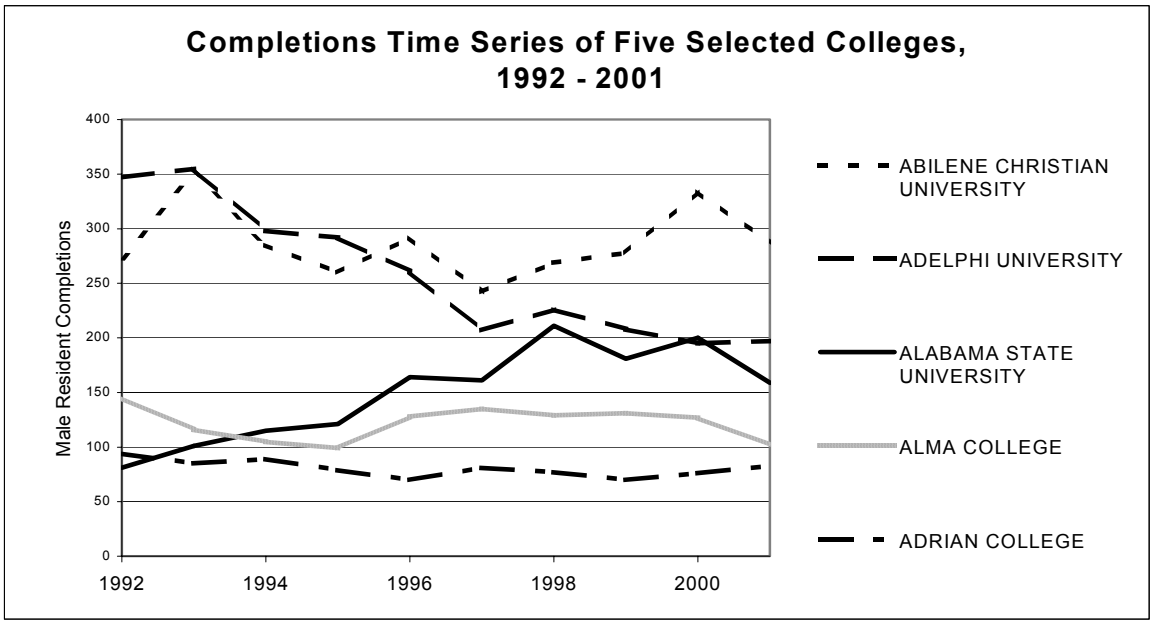


Figure 31. Time Series of Completions at Five Selected Colleges, 1992–2001. (Created by Author)

2. Methodology

This study—as in the validation phase of this research—arrives at the forecast of OCC QCP by the following steps:

- count the baccalaureate cohort using IPEDS completions;
- count the full-time enrollment subset of this cohort by multiplying the cohort by the ratio of part-time enrolled to cohort size; then
- count the test-score eligible subset nested within the full-time cohort using the Jareb-Parker quality rating.

Determination of QCP for the PLC programs requires a different approach. Table 20 displays the contribution of IPEDS data to each forecast of QCP.

Program	IPEDS Data
PLC Junior/Senior	Full-time, degree seeking, first year, first time male undergraduates Full-time, degree seeking, second year male undergraduates
PLC Combined	Full-time, degree seeking, first year, other [i.e., not first time] male undergraduates Full-time, degree seeking, third year male undergraduates
OCC	Full-time, degree seeking four year and greater male undergraduates

Table 20. Data Used to Establish QCP for Each Officer Recruiting Program. (Created by Author)

Once the database was populated, forecasts were generated using Holt's method. Holt's method is an implementation of double exponential smoothing (Abraham and Ledolter, 1983). This method is appropriate for nonstationary-nonperiodic data. It views any point forecast as an additive function of a time series level and a time series trend. Models of nonstationary data, free of seasonality, generally develop their point forecasts with equations of the form:

$$\hat{Y}_{t+n} = E_t + nT_t \tag{6.1}$$

where $\hat{Y}_{t+n}$ is the point forecast for time period $t + n$, E_t was the expected level of the time series at time t, and T_t was the estimated trend in the time series at time t. The expected level and estimated trend thus must be derived from observation of past behavior, notably:

$$\begin{aligned} E_t &= \alpha Y_t + (1-\alpha)(E_{t-1} + T_{t-1}) \\ T_t &= \beta(E_t - E_{t-1}) + (1-\beta)T_{t-1} \end{aligned} \tag{6.2}$$

where α and β are smoothing parameters that may take any values within the range [0,1].

With Holt's method, nonlinear optimization techniques determine the optimal values of the smoothing parameters by minimizing the mean square error between observed and predicted point estimates over the course of every observed series. Forecasts then carry forward the estimated value of the time series level, incrementing or decrementing each successive forecast year by the value of the trend. (Abraham and Ledolter, 1983; Ragsdale, 2001)

The study determined a separate pair of smoothing parameters α and β for each combination of ethnic group, student level and college by applying equations 6.2 to IPEDS observations for the academic years 1996–1997 through 2000–2001. To start the calculations off, Y_{1996} was assumed to equal $E_{1996,}$ with zero trend. Optimization of the smoothing parameters was performed by the Solver Add-in for Microsoft Excel. To facilitate a timely completion of the forecasts, the tolerance level for the nonlinear

solution was set at 0.001. To accomplish 50,000 iterations of a minimization problem, this study wrote a macro in the VBA programming language that guides the solver through each set of variables.

The sponsors of this research at Marine Corps Combat Development Command have expressed interest in the work. These forecasts may assist officer recruiting staffs and officer recruiters in focusing their recruiting efforts.

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VII. DISCUSSION

A. SUMMARY

The verification effort found that the model performs as discussed in the literature that accompanied the model. This research did encounter some minor omissions from the database. These omissions were corrected during expansion of the model. More importantly, the assumptions on which the model was based appear suited for the problem at hand. At the least, it appears that use of the model will support recruiting practices, as described by respondents to the OSO Census and by the historical record of commissioned officers. Incidentally, this study found that SAT and ACT thresholds applied by the Marine Corps disagree with the standards recognized by the College Board, creating a situation in which students from Midwestern colleges may face a stricter standard than students elsewhere, and in which students recruited over the past few years come from a different test-score percentile than students from years prior to 1997.

Because the actual qualified population could not be counted, this study could not validate the model. It could, however, estimate the model's accuracy by comparing its output to imputed observations. On average, the model's estimates exceed the enhanced observations by five to 20 percent, if one accepts students who complete their degrees in five years as eligible. This assumption—to count five-year students as attendance-eligible—breaks with published MCRC policy but is perhaps a better reflection of the environment faced by recruiters. If one counts only four-year completions, the model's estimates then interact with the competitiveness of individual schools, over-counting the attendance-eligible at schools with higher migration rates by at least forty percent. The static nature of the model makes it susceptible to variation in local college populations, which can occur quite rapidly. When considered by ethnic population group, the model appears to consistently overstate counts of qualified Black students by perhaps as high as 90 percent. This over-estimation appears to stem from the use of standardized test scores on which Blacks, as a group, routinely score lower than other ethnic groups. Otherwise,

the comparison suggests that the model provides a reasonable approximation of the qualified population.

This study proposes that propensity may be measured over time, in a given geographic entity, with ordinal ranking of median times between applicant commitment (contract date) and the scheduled date to begin training. The study found support for this method through descriptive, regression tree and classification tree techniques. This method may incur error in that students who must travel long distances to visit test and medical examination facilities may have artificially high delay times, and OSOs who must dedicate a lot of time on unqualified applicants may cause some qualified applicants to sign their contracts later than desired by the applicant.

To expand the model, the study increased the number of colleges within the database and populated it with U.S. Department of Education enrollment and completion counts going back to 1996. The behavior of baccalaureate cohort size is not consistent across the colleges, though most colleges exhibit a trend and irregular variation. Accordingly, the effort applied Holt's method of double exponential smoothing to the data in order to obtain over 50,000 point forecasts that will enable planners to consider the qualified population, at 1,044 colleges, for any of four ethnic populations, for any of three officer recruiting programs, through fiscal year 2004.

In conclusion, MCRC officials may place confidence in the methodology developed by Jareb and Parker, though its output, in some cases, is highly sensitive to conditions that are too local to capture with such a macro-level model. Attendance and test-score eligibility rates can change rapidly at individual schools, jeopardizing the accuracy of some forecasts. Barring this variability, the model seems to measure proportions of qualified candidates reasonably well. Given this variability, the model may underestimate counts at certain schools, though on average the model appears to overestimate the aggregate qualified population by five to twenty percent. Two exceptions stand out: Hispanic QCP within the 6th District appears understated due to exclusion of Puerto Rican colleges from the model, and counts of qualified Black students at any college appear overstated by perhaps ninety percent due to the use of test-score eligibility criteria on which Black students routinely score, on average, significantly

lower than the population used to establish score-eligibility percentiles. The enhanced spreadsheet application developed in connection with this research applies the Jareb-Parker methodology to a larger database that includes Puerto Rican colleges.

B. RECOMMENDATIONS

This study makes the following six recommendations.

First, the study recommends that Marine Corps recruiting officials continue to use a model based on the Jareb-Parker methodology to estimate QCP.

Next, the study recommends that MCRC officials develop a means to maintain the Jareb-Parker test-eligibility rates. While the counts of students within the database can be updated annually with IPEDS data, there is no such easy means to update the equally important test-eligibility rates. Two options appear feasible. MCRC officials could establish a program that gathers this information on a regular basis from the institutional research offices or registrars of the colleges that populate the model's database. The workload for this course would presumably fall upon personnel at the District or Recruiting Station level. Alternatively, MCRC could initiate a formal request to the U.S. Department of Education for this information. The department does have in place a system for handling this proprietary information that is similar to the system by which DoD agencies handle classified information.

Third, it is recommended that MCRC officials initiate measures that will increase the ability to perform future analyses of officer programs. This study encountered significant difficulties in working with ARMS data. The database is not normally used for analysis, but it serves as the most detailed source of information on people who try to obtain Marine officer commissions. The system could be improved by addition of fields that separate PLC Junior and Senior report dates, and provide a unique location for entering each type of admissions test score. Further, the ability to perform future analyses could be improved by the collection and maintenance of simple demographic data on new working applicants. Analysis of such a database would better the understanding of the kinds of students who are attracted to Marine officer programs, for little data outside the OSO Census exists to describe those who start the application process, then renege or fail to meet a qualification. It is further recommended that

MCRC, and the Marine Corps in general, change its coding of college and education codes to conform to U.S. Department of Education standards. Such a change would improve the ability of researchers to compare the educational background of Marines with the U.S. population and the literature published by research into the education system and labor force. As it now stands, this research devoted significant effort into developing lookup tables to translate Marine Corps codes into codes used by the education establishment.

Fourth, this study recommends that MCRC update its SAT-to-ACT concordance tables to reflect both the 1995 SAT recenter and annually changing concordance between these two tests. Five options appear available to address this issue. MCRC could work with the College Board to develop local concordance tables, a practice that many college admissions offices seem to adopt. MCRC could instead opt to use the national concordance tables published annually by the College Board. Also, MCRC could replace the test-score requirement with a percentile requirement, i.e., begin accepting applicants based on their rank among test-taking peers, rather than on their score alone. This option would free the organization from an annual need to update its concordance tables, and would also prepare it for anticipated, sweeping changes to the national SAT testing scheme being considered at the time of this study and widely reported in educational journals. Fourth, MCRC could bypass the problem of equating SAT, ACT, ASVAB and LSAT scores by developing and administering its own officer qualification exam. Finally, MCRC could dispense with test-score requirements in favor of basing its admission standard on a composite of proven performance, measured by any combination of high school or college class standing, grade point average, credit hour load and completion of advanced placement mathematics, science or English courses. This final course appears to be growing in popularity with college admissions personnel, and represents the admissions concept that nearly all colleges apply to transfer students.

Fifth, this study suggests that MCRC reconsider its stated intention of normally recruiting students who complete their degrees in four years. Many researchers are in agreement that the U.S. college population has changed, permanently, over the past two decades. Students are more likely to enter college without a firm commitment to a

particular institution or academic discipline. They are also more likely to stop attending college before earning a degree. But many of these uncertain college entrants eventually settle on a goal, and then migrate to another college and/or another curriculum. In the process, these students fall behind by a semester or two, but still enter the skilled labor force as responsible, educated adults. Some flexibility in the attendance-eligibility requirements may attract and hold more capable applicants.

Finally, officer recruiting may benefit from increased marketing of officer programs to college-bound high school juniors and seniors, especially those attending high schools with more rigorous mathematics programs. Review of related literature suggests that a good high school education is possibly a better predictor of timely bachelor's degree completion in college than either the SAT or grade point averages. Analysis of a small sample of YATS respondents suggests that most naval officers, as high school students, were different from their peers by being more open to (though still not committed to) commissioned service upon graduation from college.

C. OPPORTUNITY FOR FURTHER STUDY

This study finds ample opportunity for further study.

Future efforts could expand the present QCP model to better measure OCC QCP by including demographic data on the 24 – 28 year old segment of the U.S. labor force, and by considering law schools and associate's colleges. DMDC, CNA and MCRC periodically purchase expansive sets of ZIP code level market data that could support the expansion of the QCP determination into the skilled labor force.

On a similar note, the model could be refined to filter out foreign citizens on resident visas, older students and students expected to be unable to meet Marine Corps physical and medical standards. The U.S. Army Medical Statistics and Research Agency (AMSARA), based at Walter Reed Army Hospital, frequently conducts research into medical trends among recruits. This agency could be of some support to this refinement. Unfortunately, there exists no single, reliable source for data on officer program applicants who fail medical screening.

The OSO Census administered in connection with this research could support further research efforts into the field of officer recruiting.

The YATS survey offers a large and complex data set to which little attention has been paid with regard to its relevance towards officer recruiting. The sample of YATS respondents who later obtained commissions could support further research efforts into the field of officer recruiting. The sample could be expanded with matches of Air Force, Army and Coast Guard Social Security Numbers.

APPENDIX A. SUMMARY OF THE JAREB-PARKER MODEL

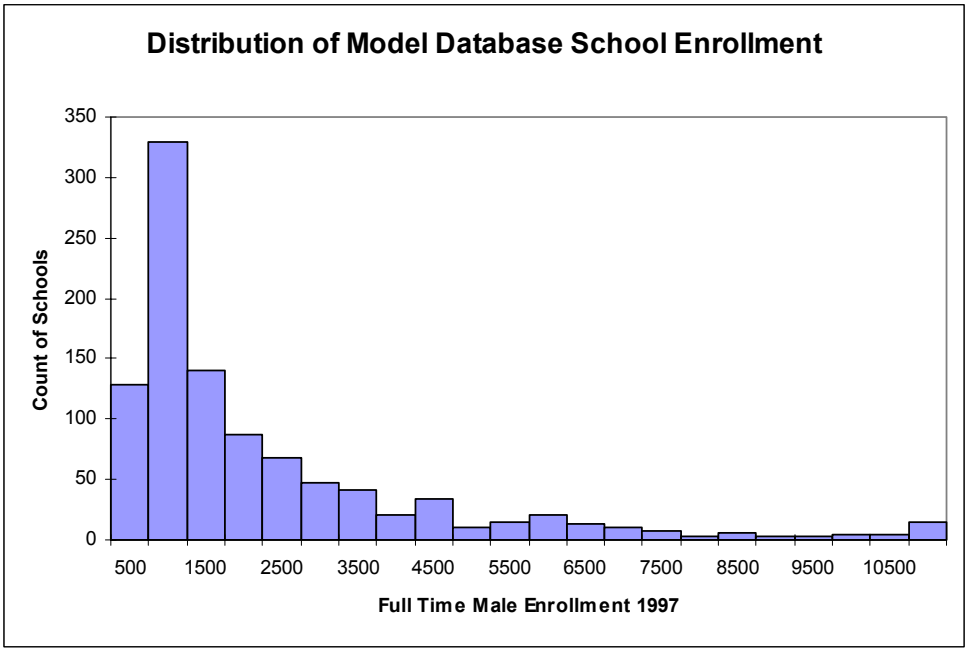
Appendix A summarizes certain qualities of schools within the original Jareb-Parker QCP Model. The table displayed in Appendix A was created by the author.

Descriptive Summary of Schools within Database

State		Barron's Group		Method	
NY:	88	COMPETITIVE:	389	ACT AVG:	19
PA:	71	VERY COMPETITIVE:	223	ACT DISTBN:	151
CA:	56	LESS COMPETITIVE:	190	CB - ACT AVG:	33
TX:	51	HIGHLY COMPETITIVE:	77	CB - SAT AVG:	92
OH:	43	NON COMPETITIVE:	76	SAT AVG:	41
MA:	41	MOST COMPETITIVE:	50	SAT DISTBN:	627
Other:	664	Other:	9	SCHOOL QUALITY:	51

Carnegie 2000 Classification		Total QCP	
Master's Colleges and Universities I:	382	Min.:	1
Baccalaureate Liberal Arts:	149	1st Qu.:	72
Doctoral Research Univ Extensive:	148	Median:	148
Baccalaureate General:	139	Mean:	308
Doctoral Research Univ Intensive:	95	3rd Qu.:	328
Master's Colleges and Universities II:	61	Max.:	3871
Other:	40		

Control	
PrivateFP:	1
PrivateNFP:	537
Public:	476



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APPENDIX B. COLLEGE SURVEY INSTRUMENTS

This Appendix presents copies of the survey instruments that were sent to college Institutional Research offices.

Survey Form A was employed during the first phase of the college survey. It was developed based on results of a presurvey of twenty colleges. Approximately 80 colleges received electronic copies of this form, attached to e-mail introductions from the author. Some institutional research offices proved hesitant to open unsolicited email attachments, and the survey's request for three years' worth of data seemed excessive to some offices. Based on this additional feedback, the form was revised so that it would "paste" into an html-formatted email rather than appear as an attachment, and so that it requested data for just the 2000-2001 academic year. Ninety colleges received the revised Form A survey.

Survey Form B was sent "pasted" into an html-formatted email to approximately 30 schools, merely to obtain a measure of their test-score eligibility rates.

Survey Form C was sent to approximately 90 schools during the second phase of the survey. Unlike Form A, this form attempts to gather information on QCP by race.

A. SURVEY FORM A

Response Form for Monterey Graduate Student				
Institution:		Office and Phone or Email:		
Instructions. This form requests information on the characteristics of successful undergraduate students at your institution. The information will support thesis research by an operations research graduate student at Naval Postgraduate School, Monterey, CA. If your institution chooses to respond, please return the form by 8 March 2002. Please direct any questions, and return your response, to Bill Hallahan at wdhallah@nps.navy.mil.				
Line	**Request**	**School Year**		
		1998-1999	**1999-2000**	**2000-2001**
1	Enter the number of male bachelor's degree recipients for the given year			
Four Year Graduates				
2	Of the population shown on Line 1, enter the number who completed their program in *4 years or less*			
3	Of the students shown on Line 2, how many have an SAT or ACT score on record with your institution?			
4	Of the students shown on Line 3, how many scored SAT(C) 1,000+ or ACT (M+V) 45+?*			
Five Year Graduates				
5	Of the population shown on Line 1, enter the number who completed their program in *5 years or less*			
6	Of the students shown on Line 5, how many have an SAT or ACT score on record with your institution?			
7	Of the students shown on Line 6, how many scored SAT(C) 1,000+ or ACT (M+V) 45+?			

*Note: those schools that do not record ACT (M +V) may substitute ACT (C) 22.5+ or some similar equivalent. If this was done, please use the spaces below to indicate the equivalent manner by which your institution records standardized entrance test scores.

	Equivalent method
The following equivalent score was substituted for the SAT(Composite) 1,000+:	

Response Form for Monterey Graduate Student	
The following equivalent score was substituted for the ACT (M+V) 45+ or Composite 22.5+	
Response Form for Monterey Graduate Student (Cont.)	

The following space is included for any comments you wish to make about the form, the data, etc. Thank you for your assistance.

B. SURVEY FORM B

Response Form for Monterey Graduate Student		
Institution:		Office and Phone or Email:
Instructions. This form requests information on a characteristic of successful undergraduate students at your institution. The information will support thesis research by an operations research graduate student at Naval Postgraduate School, Monterey, CA. If your institution chooses to respond, please return the form by 16 March 2002. Please direct any questions, and return your response, to Bill Hallahan at wdhallah@nps.navy.mil.		
Line	**Request**	**Response**
1	Enter the number of male full-time student undergraduates enrolled for purposes of a fall 2001 enrollment report.	
2	Of the students shown on Line 1, how many have an SAT or ACT score on record with your institution?	
3	Of the students shown on Line 2, how many scored SAT(C) 1,000+ or ACT (M+V) 45+?*	
*Note: those schools that do not record ACT (M +V) may substitute ACT (C) 22.5+ or some similar equivalent. If this was done, please use the spaces below to indicate the equivalent manner by which your institution records standardized entrance test scores.		
		Equivalent method
	The following equivalent score was substituted for the SAT(Composite) 1,000+:	
	The following equivalent score was substituted for the ACT (M+V) 45+ or Composite 22.5+	

Response Form for Monterey Graduate Student (Cont.)

The following space is included for any comments you wish to make about the form, the data, etc. Thank you for your assistance.

C. SURVEY FORM C

Survey Instrument for Monterey Grad Student

Instructions. This form requests information about the persistence of students at your institution. The information will be used to support research for the United States Marine Corps that considers the graduating college population. If your institution can participate, please return the completed form to wdhallah@nps.navy.mil by July 9th, 2002. Specifically, the data supports a Masters of Operations Research thesis at the Naval Postgraduate School in Monterey, CA, conducted by Maj. Bill Hallahan and advised by Dr. Sam Buttrey, PhD. The thesis attempts to validate a model used to identify the distribution of potential commissioned officers in the United States. We may also be contacted at (831) 656-2786.

Institution Name:

Office:

Phone:

		Please respond with the number of **male U.S. Citizen** students considered to belong to the following ethnic sets:			
Line	Request	White/ Caucasian	Black/African American	Hispanic	All other races
1	Please enter the number of *male* bachelor's degree recipients during the 2000-2001 academic year.				
2	Of the population shown on line 1, how many entered your institution as *transfer students*?				
3	Of the population shown on line 2, how many have SAT or ACT scores on record at your institution?				
4	Of the population shown on line 3, how many reported a combined SAT (M + V) score of at least 1000, or an ACT composite of at least 21?				

Survey Instrument for Monterey Grad Student					
5	Of the population shown on line 1, how many were members of the Fall 1997 bachelor's or equivalent degree-seeking subcohort?				
6	Of the population shown on line 5, how many have SAT or ACT scores on record at your institution?				
7	Of that number shown on line 6, how many reported a combined SAT (M + V) score of at least 1000, or an ACT composite of at least 21?				
8	Of that population shown on line 1, how many were members of the Fall 1996 bachelor's or equivalent degree-seeking subcohort?				
9	Of the population shown on line 8, how many have SAT or ACT scores on record at your institution?				
10	Of that number shown on line 9, how many reported a combined SAT (M + V) score of at least 1000, or an ACT composite of at least 21?				
11	Of that population shown on line 1, how many were members of the Fall 1995 bachelor's or equivalent degree-seeking subcohort?				
12	Of the population shown on line 11, how many have SAT or ACT scores on record at your institution?				

Survey Instrument for Monterey Grad Student					
13	Of that number shown on line 12, how many reported a combined SAT (M + V) score of at least 1000, or an ACT composite of at least 21?				
14	What was your institution's last computed *four-year* graduation rate?				
15	What was your institution's last computed *five-year* graduation rate?				
16	What was your institution's last computed *six-year* graduation rate?				

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APPENDIX C. ENHANCED QCP OBSERVATIONS

This appendix presents the data obtained from the college surveys, and the imputations applied to create enhanced observations of QCP

A. ALPHABETICAL LISTING OF PARTICIPATING COLLEGES, WITH LOCATION, CARNEGIE AND BARRON'S CLASSIFICATIONS

Institution	State	County	City	Carnegie	Barrons
Albright College	PA	BERKS	Reading	Baccalaureate Liberal Arts	LESS COMPETITIVE
Arkansas State University	AR	CRAIGHEAD	State University	Master's Colleges and Universities I	COMPETITIVE
Arkansas Tech University	AR	POPE	Russellville	Master's Colleges and Universities I	COMPETITIVE
Bates College	ME	ANDROSCOGGIN	Lewiston	Baccalaureate Liberal Arts	MOST COMPETITIVE
Brigham Young University	UT	UTAH	Provo	Doctoral Research Univ Extensive	HIGHLY COMPETITIVE
California State University-Fresno	CA	FRESNO	Fresno	Master's Colleges and Universities I	COMPETITIVE
Claremont McKenna College	CA	LOS ANGELES	Claremont	Baccalaureate Liberal Arts	MOST COMPETITIVE
East Carolina University	NC	PITT	Greenville	Doctoral Research Univ Intensive	COMPETITIVE
Florida State University	FL	LEON	Tallahassee	Doctoral Research Univ Extensive	HIGHLY COMPETITIVE
Georgia Southern University	GA	BULLOCH	Statesboro	Master's Colleges and Universities I	COMPETITIVE
Ithaca College	NY	TOMPKINS	Ithaca	Master's Colleges and Universities I	VERY COMPETITIVE
Jamestown College	ND	STUTSMAN	Jamestown	Baccalaureate General	NON COMPETITIVE
Lawrence University	WI	OUTAGAMIE	Appleton	Baccalaureate Liberal Arts	HIGHLY COMPETITIVE
Lewis University	IL	WILL	Romeoville	Master's Colleges and Universities I	COMPETITIVE
Nazareth College of Rochester	NY	MONROE	Rochester	Master's Colleges and Universities I	VERY COMPETITIVE
Ohio State University Main Campus, The	OH	FRANKLIN	Columbus	Doctoral Research Univ Extensive	VERY COMPETITIVE
Ouachita Baptist University	AR	CLARK	Arkadelphia	Baccalaureate General	VERY COMPETITIVE
Quincy University	IL	ADAMS	Quincy	Master's Colleges and Universities II	COMPETITIVE
Randolph-Macon College	VA	HANOVER	Ashland	Baccalaureate Liberal Arts	VERY COMPETITIVE
Rice University	TX	HARRIS	Houston	Doctoral Research Univ Extensive	MOST COMPETITIVE

Institution	State	County	City	Carnegie	Barrons
Taylor University Upland	IN	GRANT	Fort Wayne	Baccalaureate General	VERY COMPETITIVE
Texas Tech University	TX	LUBBOCK	Lubbock	Doctoral Research Univ Extensive	VERY COMPETITIVE
The University of Montana-Missoula	MT	MISSOULA	Missoula	Doctoral Research Univ Intensive	COMPETITIVE
Trinity College	CT	HARTFORD	Hartford	Baccalaureate Liberal Arts	HIGHLY COMPETITIVE
University of California-Berkeley	CA	ALAMEDA	Berkeley	Doctoral Research Univ Extensive	MOST COMPETITIVE
University of California-Santa Cruz	CA	SANTA CRUZ	Santa Cruz	Doctoral Research Univ Extensive	HIGHLY COMPETITIVE
University of North Florida	FL	DUVAL	Jacksonville	Master's Colleges and Universities I	VERY COMPETITIVE
University of Northern Colorado	CO	WELD	Greeley	Doctoral Research Univ Intensive	COMPETITIVE
University of South Alabama	AL	MOBILE	Mobile	Doctoral Research Univ Intensive	COMPETITIVE
University of Southern Indiana	IN	VANDERBURGH	Evansville	Master's Colleges and Universities I	LESS COMPETITIVE
University of Virginia	VA	ALBEMARLE	Charlottesville	Doctoral Research Univ Extensive	MOST COMPETITIVE
West Texas A&M University	TX	RANDALL	Canyon	Master's Colleges and Universities I	COMPETITIVE
Western Michigan University	MI	KALAMAZOO	Kalamazoo	Doctoral Research Univ Extensive	COMPETITIVE
Western State College Colorado	CO	GUNNISON	Gunnison	Baccalaureate Liberal Arts	LESS COMPETITIVE
Yale University	CT	NEW HAVEN	New Haven	Doctoral Research Univ Extensive	MOST COMPETITIVE

B. ALPHABETICAL LISTING OF SURVEYS RECEIVED FROM PARTICIPATING SCHOOLS, SHOWING SIZE OF BACCALUARTE COHORT

This table lists each complete survey received. Some schools are listed more than once because some schools submitted multiple surveys, each for a different cohort. The fields of the table display: each school's U.S. Department of Education Unit Identification code (**UNITID**); the academic year of the surveyed class (**Year**); the ACT score, equivalent to a combined SAT of 1000, established by the school when handling classes with mixed SAT- and ACT-reporting students (**ACTEquiv**); the method applied by Jareb and Parker in establishing the school's QCP (**method**); the school's reported number of academic year bachelor's completions (**Comp**); the quartile in which the school placed, as a member of the model's dataset, based upon the percent of full-time enrolled students who complete their degree at the school (**C_Quart**); and a remark indicating whether the school falls under public or private, not for profit control (**Control**) .

Institution	UNITID	Year	ACTEquiv	method	Comp	C_Quart	Control
Albright College	210571	2000-2001	21	SAT DISTBN	127	1	PrivateNFP
Albright College	210571	1999-2000	21	SAT DISTBN	127	1	PrivateNFP
Albright College	210571	1998-1999	21	SAT DISTBN	127	1	PrivateNFP
Arkansas State University	106458	2000-2001	21	ACT DISTBN	532	3	Public
Arkansas Tech University	106467	2000-2001	21	ACT DISTBN	274	3	Public
Bates College	160977	2000-2001	21	SAT DISTBN	189	2	PrivateNFP
Bates College	160977	1999-2000	21	SAT DISTBN	189	2	PrivateNFP
Brigham Young University	230038	2000-2001	21	ACT DISTBN	3279	4	PrivateNFP
California State University-Fresno	110556	2000-2001	22.5	SAT DISTBN	1146	4	Public
Claremont McKenna College	112260	2000-2001	21	SAT DISTBN	150	2	PrivateNFP
East Carolina University	198464	2000-2001	21	SAT DISTBN	1130	4	Public
East Carolina University	198464	1999-2000	21	SAT DISTBN	1130	4	Public
Florida State University	134097	2000-2001	23	SAT DISTBN	2287	4	Public
Florida State University	134097	1999-2000	23	SAT DISTBN	2287	4	Public
Georgia Southern University	139931	2000-2001	21	SAT DISTBN	790	4	Public
Georgia Southern University	139931	1999-2000	21	SAT DISTBN	790	4	Public

Institution	UNITID	Year	ACTEquiv	method	Comp	C_Quart	Control
Georgia Southern University	139931	1998-1999	21	SAT DISTBN	790	4	Public
Ithaca College	191968	2000-2001	21	SAT DISTBN	519	3	PrivateNFP
Ithaca College	191968	1999-2000	21	SAT DISTBN	519	3	PrivateNFP
Ithaca College	191968	1998-1999	21	SAT DISTBN	519	3	PrivateNFP
Jamestown College	200156	2000-2001	22.5	ACT DISTBN	80	1	PrivateNFP
Lawrence University	239017	2000-2001	21	SAT DISTBN	82	1	PrivateNFP
Lawrence University	239017	1999-2000	21	SAT DISTBN	82	1	PrivateNFP
Lawrence University	239017	1998-1999	21	SAT DISTBN	82	1	PrivateNFP
Lewis University	146612	2000-2001	21	ACT DISTBN	266	3	PrivateNFP
Nazareth College of Rochester	193584	2000-2001	21	SAT DISTBN	110	1	PrivateNFP
Nazareth College of Rochester	193584	1999-2000	21	SAT DISTBN	110	1	PrivateNFP
Nazareth College of Rochester	193584	1998-1999	21	SAT DISTBN	110	1	PrivateNFP
Ohio State University Main Campus, The	204796	2000-2001	21	SAT DISTBN	3237	4	Public
Ohio State University Main Campus, The	204796	1999-2000	21	SAT DISTBN	3237	4	Public
Ohio State University Main Campus, The	204796	1998-1999	21	SAT DISTBN	3237	4	Public
Ouachita Baptist University	107512	2000-2001	21	SAT DISTBN	134	2	PrivateNFP
Quincy University	148131	2000-2001	21	SAT DISTBN	82	1	PrivateNFP
Quincy University	148131	1999-2000	21	SAT DISTBN	82	1	PrivateNFP
Quincy University	148131	1998-1999	21	SAT DISTBN	82	1	PrivateNFP
Randolph-Macon College	233295	2000-2001	21	SAT DISTBN	100	1	PrivateNFP
Randolph-Macon College	233295	1999-2000	21	SAT DISTBN	100	1	PrivateNFP
Rice University	227757	2000-2001	21	CB - SAT AVG	363	3	PrivateNFP
Taylor University Upland	150561	2000-2001	21	SAT DISTBN	175	2	PrivateNFP
Taylor University Upland	150561	1999-2000	21	SAT DISTBN	175	2	PrivateNFP
Taylor University Upland	150561	1998-1999	21	SAT DISTBN	175	2	PrivateNFP
Texas Tech University	229115	2000-2001	21	SAT DISTBN	1866	4	Public
The University of Montana-Missoula	180489	2000-2001	23	SAT DISTBN	764	4	Public

The University of Montana-Missoula	180489	1999-2000	23	SAT DISTBN	764	4	Public
The University of Montana-Missoula	180489	1998-1999	23	SAT DISTBN	764	4	Public
Trinity College	130590	2000-2001	21	SAT DISTBN	264	3	PrivateNFP
University of California-Berkeley	110635	2000-2001	22.5	SAT DISTBN	2576	4	Public
University of California-Santa Cruz	110714	2000-2001	21	SAT DISTBN	972	4	Public
University of North Florida	136172	2000-2001	22.5	SAT DISTBN	689	4	Public
University of North Florida	136172	1999-2000	22.5	SAT DISTBN	689	4	Public
University of North Florida	136172	1998-1999	22.5	SAT DISTBN	689	4	Public
University of Northern Colorado	127741	2000-2001	21	SAT DISTBN	605	4	Public
University of Northern Colorado	127741	1999-2000	21	SAT DISTBN	605	4	Public
University of Northern Colorado	127741	1998-1999	21	SAT DISTBN	605	4	Public
University of South Alabama	102094	2000-2001	21	ACT DISTBN	435	3	Public
University of South Alabama	102094	1999-2000	21	ACT DISTBN	435	3	Public
University of South Alabama	102094	1998-1999	21	ACT DISTBN	435	3	Public
University of Southern Indiana	151306	2000-2001	21	SAT DISTBN	350	3	Public
University of Southern Indiana	151306	1999-2000	21	SAT DISTBN	350	3	Public
University of Southern Indiana	151306	1998-1999	21	SAT DISTBN	350	3	Public
University of Virginia	234076	2000-2001	21	SAT DISTBN	1404	4	Public
University of Virginia	234076	1999-2000	21	SAT DISTBN	1404	4	Public
West Texas A&M University	229814	2000-2001	21	SAT DISTBN	365	3	Public
West Texas A&M University	229814	1999-2000	21	SAT DISTBN	365	3	Public
West Texas A&M University	229814	1998-1999	21	SAT DISTBN	365	3	Public
Western Michigan University	172699	2000-2001	21	ACT DISTBN	1468	4	Public
Western State College Colorado	128391	2000-2001	21	SAT DISTBN	250	3	Public
Yale University	130794	2000-2001	21	SAT AVG	588	4	PrivateNFP
Yale University	130794	1999-2000	21	SAT AVG	588	4	PrivateNFP
Yale University	130794	1998-1999	21	SAT AVG	588	4	PrivateNFP

C. ALPHABETICAL LISTING OF SURVEYS RECEIVED, SHOWING SURVEY FORM AND COHORT DETAILS

This table displays the following information about the surveys received: the reported size of its baccalaureate cohort (**BaccaluareateCohort**); the number of students within that cohort who completed their degree requirements within four years, on a full-time basis (**4yearFTFcohort**); the number of students within that cohort who completed their degree requirements within five years, on a full-time basis (**5yearFTFcohort**); and the academic year of the cohort (**Year**). A designation of "nr" indicates "not reported."

Institution	Year	Baccalaureate Cohort	4year FTFcohort	5year FTFcohort
Albright College	2000-2001	115	81	16
Albright College	1999-2000	151	78	18
Albright College	1998-1999	115	69	10
Arkansas State University	2000-2001	555	128	116
Arkansas Tech University	2000-2001	282	31	56
Bates College	2000-2001	199	nr	nr
Bates College	1999-2000	218	nr	nr
Brigham Young University	2000-2001	3361	801	216
California State University-Fresno	2000-2001	1156	56	109
Claremont McKenna College	2000-2001	150	122	7
East Carolina University	2000-2001	1135	nr	nr
East Carolina University	1999-2000	1101	nr	nr
Florida State University	2000-2001	2287	502	446
Florida State University	1999-2000	2269	580	406
Georgia Southern University	2000-2001	788	523	147
Georgia Southern University	1999-2000	754	516	135
Georgia Southern University	1998-1999	734	500	132
Ithaca College	2000-2001	519	360	61
Ithaca College	1999-2000	541	352	90
Ithaca College	1998-1999	580	442	43
Jamestown College	2000-2001	81	39	33
Lawrence University	2000-2001	82	64	15
Lawrence University	1999-2000	104	74	5

Institution	Year	Baccalaureate Cohort	4year FTFcohort	5year FTFcohort
Lawrence University	1998-1999	113	102	8
Lewis University	2000-2001	282	65	45
Nazareth College of Rochester	2000-2001	111	69	23
Nazareth College of Rochester	1999-2000	95	67	15
Nazareth College of Rochester	1998-1999	95	67	8
Ohio State University Main Campus, The	2000-2001	3149	631	972
Ohio State University Main Campus, The	1999-2000	3065	593	853
Ohio State University Main Campus, The	1998-1999	3078	528	946
Ouachita Baptist University	2000-2001	135	8	51
Quincy University	2000-2001	76	56	11
Quincy University	1999-2000	96	78	14
Quincy University	1998-1999	88	69	8
Randolph-Macon College	2000-2001	100	71	8
Randolph-Macon College	1999-2000	97	87	10
Rice University	2000-2001	361	262	69
Taylor University Upland	2000-2001	182	145	20
Taylor University Upland	1999-2000	221	150	33
Taylor University Upland	1998-1999	169	114	22
Texas Tech University	2000-2001	1950	291	438
The University of Montana-Missoula	2000-2001	764	314	61
The University of Montana-Missoula	1999-2000	746	282	54
The University of Montana-Missoula	1998-1999	744	241	60
Trinity College	2000-2001	258	207	20
University of California-Berkeley	2000-2001	2683	853	670
University of California-Santa Cruz	2000-2001	1005	326	213
University of North Florida	2000-2001	689	103	49
University of North Florida	1999-2000	667	63	42
University of North Florida	1998-1999	660	53	39

Institution	Year	Baccalaureate Cohort	4year FTFcohort	5year FTFcohort
University of Northern Colorado	2000-2001	578	89	118
University of Northern Colorado	1999-2000	651	102	149
University of Northern Colorado	1998-1999	591	71	131
University of South Alabama	2000-2001	505	234	112
University of South Alabama	1999-2000	526	240	101
University of South Alabama	1998-1999	584	279	107
University of Southern Indiana	2000-2001	350	55	97
University of Southern Indiana	1999-2000	346	40	99
University of Southern Indiana	1998-1999	262	24	53
University of Virginia	2000-2001	1360	nr	nr
University of Virginia	1999-2000	1318	nr	nr
West Texas A&M University	2000-2001	385	155	101
West Texas A&M University	1999-2000	359	185	82
West Texas A&M University	1998-1999	357	178	79
Western Michigan University	2000-2001	1468	178	348
Western State College Colorado	2000-2001	250	28	57
Yale University	2000-2001	620	552	48
Yale University	1999-2000	659	608	34
Yale University	1998-1999	626	574	39

D. ALPHABETICAL LISTING OF SURVEYS RECEIVED, SHOWING TRANSFER STUDENTS

The following table displays: the number of transfer students reported within a given baccalaureate cohort (**Transfers**); the number of "non-traditional" students within a given baccalaureate cohort (**Remainder**); the percent of members within the baccalaureate cohort who completed their degree requirements on a full-time basis (**AttendanceFactor**); the percent of members within the baccalaureate cohort about whom this study had to impute a percentage of full-time completion (**ImputationRate**) (i.e., the percent of transfer students who appear to have completed their degree requirements on a full-time basis); and the number of transfer baccalaureate recipients in a given year whom this study implies completed their degree on a full-time basis (**RemainderAttEligible**).

Institution	Year	Transfers	Remainder	AttendanceFactor	ImputationRate	Remainder AttEligible
Albright College	2000-2001		18	0.853	0.335	46
Albright College	1999-2000		55	0.853	0.468	81
Albright College	1998-1999		36	0.853	0.492	74
Arkansas State University	2000-2001	232	79	0.794	0.531	263
Arkansas Tech University	2000-2001	122	73	0.798	0.579	119
Bates College	2000-2001		199	1.000	0.597	200
Bates College	1999-2000		218	1.000	0.584	219
Brigham Young University	2000-2001	1303	1041	0.833	0.557	1199
California State University-Fresno	2000-2001	755	236	0.764	0.818	650
Claremont McKenna College	2000-2001	16	5	0.995	0.110	16
East Carolina University	2000-2001	nr	nr	0.898	0.260	nr
East Carolina University	1999-2000	nr	nr	0.898	0.335	nr
Florida State University	2000-2001		1339	0.834	0.472	1294
Florida State University	1999-2000		1283	0.834	0.456	1313
Georgia Southern University	2000-2001		118	0.885	0.420	381

Institution	Year	Transfers	Remainder	AttendanceFactor	ImputationRate	Remainder AttEligible
Georgia Southern University	1999-2000		103	0.885	0.411	352
Georgia Southern University	1998-1999		102	0.885	0.420	327
Ithaca College	2000-2001		98	0.977	0.248	139
Ithaca College	1999-2000		99	0.977	0.275	168
Ithaca College	1998-1999		95	0.977	0.338	248
Jamestown College	2000-2001		9	0.940	0.447	23
Lawrence University	2000-2001		3	0.934	0.175	17
Lawrence University	1999-2000		25	0.934	0.228	23
Lawrence University	1998-1999		3	0.934	0.042	5
Lewis University	2000-2001	159	13	0.448	0.564	84
Nazareth College of Rochester	2000-2001		19	0.883	0.259	23
Nazareth College of Rochester	1999-2000		13	0.883	0.307	23
Nazareth College of Rochester	1998-1999		20	0.883	0.407	36
Ohio State University Main Campus, The	2000-2001	950	596	0.823	0.444	1222
Ohio State University Main Campus, The	1999-2000	965	654	0.823	0.482	1289
Ohio State University Main Campus, The	1998-1999	963	641	0.823	0.487	1343
Ouachita Baptist University	2000-2001	8	68	0.938	0.285	24
Quincy University	2000-2001		9	0.948	0.353	25
Quincy University	1999-2000		4	0.948	0.371	38
Quincy University	1998-1999		11	0.948	0.396	33
Randolph-Macon College	2000-2001		21	0.965	0.358	41
Randolph-Macon College	1999-2000	0	0	0.965	0.336	36
Rice University	2000-2001	14	16	0.968	0.051	18
Taylor University Upland	2000-2001		17	0.649	0.138	26

Institution	Year	Transfers	Remainder	AttendanceFactor	ImputationRate	Remainder AttEligible
Taylor University Upland	1999-2000		38	0.649	0.207	47
Taylor University Upland	1998-1999		33	0.649	0.220	38
Texas Tech University	2000-2001	857	364	0.887	0.560	927
The University of Montana-Missoula	2000-2001		389	0.847	0.569	441
The University of Montana-Missoula	1999-2000		410	0.847	0.599	446
The University of Montana-Missoula	1998-1999		443	0.847	0.636	477
Trinity College	2000-2001	18	13	0.921	0.081	20
University of California-Berkeley	2000-2001	800	360	0.909	0.332	754
University of California-Santa Cruz	2000-2001	453	13	0.935	0.493	476
University of North Florida	2000-2001		537	0.319	0.571	202
University of North Florida	1999-2000		562	0.319	0.680	223
University of North Florida	1998-1999		568	0.319	0.709	224
University of Northern Colorado	2000-2001	300	71	0.865	0.641	367
University of Northern Colorado	1999-2000	334	66	0.865	0.631	425
University of Northern Colorado	1998-1999	279	110	0.865	0.632	342
University of South Alabama	2000-2001		159	0.524	0.500	158
University of South Alabama	1999-2000		185	0.524	0.511	187
University of South Alabama	1998-1999		198	0.524	0.505	181
University of Southern Indiana	2000-2001		198	0.666	0.648	177
University of Southern Indiana	1999-2000		207	0.666	0.672	201
University of Southern Indiana	1998-1999		185	0.666	0.742	149
University of Virginia	2000-2001	nr	nr	#N/A	0.000	
University of Virginia	1999-2000	nr	nr	#N/A	0.000	

Institution	Year	Transfers	Remainder	AttendanceFactor	ImputationRate	Remainder AttEligible
West Texas A&M University	2000-2001		129	0.766	0.544	196
West Texas A&M University	1999-2000		92	0.766	0.494	145
West Texas A&M University	1998-1999		100	0.766	0.524	136
Western Michigan University	2000-2001	615	327	0.761	0.532	593
Western State College Colorado	2000-2001	116	49	0.962	0.657	163
Yale University	2000-2001		20	0.990	0.032	20
Yale University	1999-2000		17	0.990	0.026	17
Yale University	1998-1999		13	0.990	0.023	14

E. ALPHABETICAL LISTING OF SURVEYS RECEIVED, SHOWING MODEL AND IMPUTED QCP, AND RHO

The following table displays: the number of qualified candidates reported, and imputed from, a given survey (**RawObservedQCP**); a binary variable indicating whether the reported QCP accounts for nonresident aliens (**NRAIncl**); the observed QCP, adjusted for presence of nonresident aliens (**AdjObsQCP**); the QCP predicted by the Jareb-Parker model (**ModelQCP**); the ratio of predicted over observed QCP (**Rho**); and the difference between observed and predicted QCP (**Delta**).

Institution	Year	RawObservedQCP	NRAIncl	AdjObsQCP	ModelQCP	Rho	Delta
Albright College	2000-2001	92	1	87	59	0.680	28
Albright College	1999-2000	109	1	103	59	0.572	44
Albright College	1998-1999	65	1	61	59	0.959	2
Arkansas State University	2000-2001	328	1	310	245	0.790	65
Arkansas Tech University	2000-2001	154	0	154	149	0.966	5
Bates College	2000-2001	333	0	333	225	0.677	108
Bates College	1999-2000	373	0	373	225	0.604	148
Brigham Young University	2000-2001	1898	0	1898	3044	1.604	-1146
California State University-Fresno	2000-2001	395	0	395	412	1.044	-17
Claremont McKenna College	2000-2001	145	0	145	195	1.346	-50
East Carolina University	2000-2001	465	1	440	610	1.388	-170
East Carolina University	1999-2000	345	1	326	610	1.869	-285
Florida State University	2000-2001	2407	0	2407	2127	0.884	280
Florida State University	1999-2000	2432	0	2432	2127	0.875	305
Georgia Southern University	2000-2001	431	0	431	484	1.123	-53
Georgia Southern University	1999-2000	413	0	413	484	1.173	-71
Georgia Southern University	1998-1999	369	0	369	484	1.311	-115
Ithaca College	2000-2001	503	0	503	444	0.883	59
Ithaca College	1999-2000	512	0	512	444	0.868	68
Ithaca College	1998-1999	499	0	499	444	0.890	55
Jamestown College	2000-2001	25	0	25	39	1.540	-14

Institution	Year	RawObservedQCP	NRAIncl	AdjObsQCP	ModelQCP	Rho	Delta
Lawrence University	2000-2001	79	1	75	101	1.354	-26
Lawrence University	1999-2000	102	1	97	101	1.043	-4
Lawrence University	1998-1999	113	1	107	101	0.947	6
Lewis University	2000-2001	119	1	113	104	0.921	9
Nazareth College of Rochester	2000-2001	80	1	75	77	1.022	-2
Nazareth College of Rochester	1999-2000	59	1	56	77	1.376	21
Nazareth College of Rochester	1998-1999	57	1	54	77	1.420	-23
Ohio State University Main Campus, The	2000-2001	1962	1	1856	2536	1.367	-680
Ohio State University Main Campus, The	1999-2000	1716	1	1623	2536	1.562	-913
Ohio State University Main Campus, The	1998-1999	1686	1	1595	2536	1.590	-941
Ouachita Baptist University	2000-2001	60	0	60	93	1.547	-33
Quincy University	2000-2001	45	1	42	59	1.392	-17
Quincy University	1999-2000	48	1	45	59	1.307	-14
Quincy University	1998-1999	46	1	44	59	1.345	-15
Randolph-Macon College	2000-2001	83	1	78	83	1.063	-5
Randolph-Macon College	1999-2000	53	1	50	83	1.663	-33
Rice University	2000-2001	340	1	322	345	1.072	-23
Taylor University Upland	2000-2001	171	1	161	158	0.979	3
Taylor University Upland	1999-2000	198	1	187	158	0.844	29
Taylor University Upland	1998-1999	153	1	144	158	1.094	-14
Texas Tech University	2000-2001	1274	0	1274	1504	1.180	-230
The University of Montana-Missoula	2000-2001	517	0	517	403	0.780	114
The University of Montana-Missoula	1999-2000	498	0	498	403	0.808	95
The University of Montana-Missoula	1998-1999	470	0	470	403	0.858	67
Trinity College	2000-2001	238	0	238	207	0.869	31
University of California-Berkeley	2000-2001	2230	0	2230	2695	1.209	-465

Institution	Year	RawObservedQCP	NRAIncl	AdjObsQCP	ModelQCP	Rho	Delta
University of California-Santa Cruz	2000-2001	862	0	862	794	0.921	68
University of North Florida	2000-2001	282	0	282	488	1.730	-206
University of North Florida	1999-2000	191	0	191	488	2.558	-297
University of North Florida	1998-1999	168	0	168	488	2.897	-320
University of Northern Colorado	2000-2001	273	1	258	375	1.453	-117
University of Northern Colorado	1999-2000	306	1	289	375	1.296	-86
University of Northern Colorado	1998-1999	267	1	252	375	1.487	-123
University of South Alabama	2000-2001	166	1	157	218	1.387	-61
University of South Alabama	1999-2000	182	1	172	218	1.267	-46
University of South Alabama	1998-1999	202	1	191	218	1.140	-27
University of Southern Indiana	2000-2001	145	0	145	94	0.649	51
University of Southern Indiana	1999-2000	107	0	107	94	0.881	13
University of Southern Indiana	1998-1999	101	0	101	94	0.934	7
University of Virginia	2000-2001	1339	0	1339	1323	0.988	16
University of Virginia	1999-2000	1309	0	1309	1323	1.011	-14
West Texas A&M University	2000-2001	147	11	139	212	1.524	-73
West Texas A&M University	1999-2000	146	1	138	212	1.532	-74
West Texas A&M University	1998-1999	135	1	127	212	1.665	-85
Western Michigan University	2000-2001	847	0	847	948	1.120	-101
Western State College Colorado	2000-2001	99	0	99	96	0.969	3
Yale University	2000-2001	612	1	579	641	1.108	-62
Yale University	1999-2000	652	1	617	641	1.040	-24
Yale University	1998-1999	612	1	579	641	1.107	-62

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APPENDIX D. OBSERVED TEST-ELIGIBILITY RATES

This appendix presents the test-score eligibility rates obtained from the college surveys. They are presented in order of largest *over*estimation by the model, through zero difference, to largest *under*estimation by the model. The fields of the table display: each school's U.S. Department of Education Unit Identification code (**UNITID**); the ACT score, equivalent to a combined SAT of 1,000, established by the school when handling classes with mixed SAT- and ACT-reporting students (**ACTEquiv**) (Note: the University of West Florida used a SAT verbal score of 490 to compute an equivalent of SAT combined score of 1,000); the observed rate of test-score eligibility within the entire student body (**OBS_RATE**), based on the fall 2001 head count; the rate of test-score eligibility predicted by the Jareb-Parker model (**PRED_RATE**); the difference between the observed and predicted rates (**Difference**); the Barron's rating of the institution (**Barrons**); and the method applied by Jareb-Parker to establish the school's QCP (**Method**).

Institution	UNITID	ACT	OBS_ RATE	PRED_RATE	Difference	Barrons	Method
Rutgers, The State University of New Jersey, New Brunswick Campus	186380		0.63	0.886	-0.26	Highly Comp	SAT DISTBN
Randolph-Macon College	233295		0.49	0.75	-0.26	Very Comp	SAT DISTBN
Brigham Young University	230038	21	0.75	0.93	-0.18	Highly Comp	ACT DISTBN
University of West Florida	138354	490 verbal SAT	0.57	0.75	-0.18	Comp	SAT DISTBN
West Texas A&M University	229814		0.41	0.54	-0.13	Comp	SAT DISTBN
Georgia Southern University	139931		0.47	0.6	-0.13	Comp	SAT DISTBN

Lawrence University	239017		0.82	0.94	-0.12	Highly Comp	SAT DISTBN
University of Northern Colorado	127741		0.48	0.57	-0.09	Comp	SAT DISTBN
Western State College Colorado	128391	21	0.40	0.48	-0.08	Less Comp	SAT DISTBN
Ohio State University Main Campus, The	204796		0.71	0.78	-0.07	Very Comp	SAT DISTBN
Jamestown College	200156	22.5	0.48	0.525	-0.04	NonComp	ACT DISTBN
University of Nevada, Reno	182290		0.57	0.6	-0.03	Comp	SAT DISTBN
University of North Florida	136172	22.5	0.80	0.82	-0.02	Very Comp	SAT DISTBN
The University of Montana-Missoula	180489	23	0.67	0.68	-0.01	Comp	SAT DISTBN
California State University-Hayward	110574		0.42	0.42	0.00	Less Comp	SCHOOL QUALITY
Claremont McKenna College	112260	21	1.00	1	0.00	Most Comp	SAT DISTBN
University of South Alabama	102094		0.53	0.525	0.00	Comp	ACT DISTBN
Bates College	160977		0.99	0.99	0.00	Most Comp	SAT DISTBN
Yale University	130794		1.00	0.99	0.01	Most Comp	SAT AVG
Quincy University	148131		0.64	0.63	0.01	Comp	SAT DISTBN
Texas A&M University	228723	45	0.88	0.86	0.02	Highly Comp	SAT DISTBN
Ithaca College	191968		0.90	0.86	0.04	Very Comp	SAT DISTBN
Ouachita Baptist University	107512	21	0.73	0.69	0.04	Very Comp	SAT DISTBN
University of California-Berkeley	110635	22.5	0.98	0.94	0.04	Most Comp	SAT DISTBN
Taylor University Upland	152530		0.91	0.85	0.06	Very Comp	SAT DISTBN

Drexel University	212054		0.91	0.84	0.07	Very Comp	SAT DISTBN
Florida State University	134097	23	0.88	0.8	0.08	Highly Comp	SAT DISTBN
University of California-Santa Cruz	110714	21	0.89	0.81	0.08	Highly Comp	SAT DISTBN
University of Texas at Austin	228778		0.96	0.88	0.08	Highly Comp	SAT DISTBN
Nazareth College of Rochester	193584		0.91	0.82	0.09	Very Comp	SAT DISTBN
Shippensburg University of Pennsylvania	216010		0.73	0.64	0.09	Comp	SAT DISTBN
Albright College	210571		0.66	0.57	0.09	Less Comp	SAT DISTBN
University of Texas at Arlington	228769	22.5	0.70	0.6	0.10	Less Comp	SAT DISTBN
San Diego State University	122409		0.66	0.54	0.12	Comp	SAT DISTBN
Indiana University-Purdue University Indianapolis	151111		0.50	0.35	0.15	Less Comp	SAT AVG
City University of New York Bernard M. Baruch College	190512		0.69	0.54	0.15	Very Comp	SAT DISTBN
Arkansas State University	106458	21	0.66	0.505	0.16	Comp	ACT DISTBN
California State University-Fresno	110556	22.5	0.50	0.34	0.16	Comp	SAT DISTBN
University of Southern Indiana	151306		0.53	0.36	0.17	Less Comp	SAT DISTBN
Arkansas Tech University	106467	21	0.75	0.455	0.29	Comp	ACT DISTBN
Lewis University	146612	21	0.80	0.365	0.44	Comp	ACT DISTBN

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APPENDIX E. ENHANCED JAREB-PARKER MODEL

This appendix discusses enhancements to the Jareb-Parker QCP model.

Twenty-six colleges that otherwise met the original enrollment threshold were excluded from the model database because they are located in U.S. Territories. These schools are listed in the following table, along with three other colleges that met the criterion for entry into the database. This study believes the model would also benefit from inclusion of Embry-Riddle Aeronautical University-Prescott Campus. Unfortunately, the NCES does not include the campus in its publicly accessible database.

These schools presented a challenge with estimating the percent of eligible students within their undergraduate populations. The schools located within U.S. States are rated in the manner developed by Jareb and Parker. This study failed to obtain test scores or Barron's data on the schools in the outlying areas, however, so they are rated comparably to HBCU located within the States at 15% test-score eligible. This rating, while clearly beneath the admissions requirements of the more selective Puerto Rican private colleges, perhaps reflects the additional loss of QCP from these schools due to language barriers, and is accepted by the Officer Selection Officer currently responsible for recruiting in Puerto Rico (Lenard, 2002).

IPEDS UnitID	School	City	State
241100	AMERICAN UNIVERSITY OF PUERTO RICO	BAYAMON	PR
241128	AMERICAN UNIVERSITY OF PUERTO RICO	MANATI	PR
241225	BAYAMON CENTRAL UNIVERSITY	BAYAMON	PR
243346	COLEGIO UNIVERSITARIO DEL ESTE	CAROLINA	PR
151388	INDIANA UNIVERSITY-EAST	RICHMOND	IN
242626	INTER AMERICAN UNIV OF PUERTO RICO-AGUADILLA	AGUADILLA	PR
242635	INTER AMERICAN UNIV OF PUERTO RICO-ARECIBO	ARECIBO	PR
242705	INTER AMERICAN UNIV OF PUERTO RICO-BAYAMON	BAYAMON	PR

242699	INTER AMERICAN UNIV OF PUERTO RICO-GUAYAMA	GUAYAMA	PR
242653	INTER AMERICAN UNIV OF PUERTO RICO-METRO	RIO PIEDRAS	PR
242662	INTER AMERICAN UNIV OF PUERTO RICO-PONCE	MERCEDITA	PR
242617	INTER AMERICAN UNIV OF PUERTO RICO-SAN GERMAN	SAN GERMAN	PR
243586	PONTIFICAL CATHOLIC UNIV OF PUERTO RICO-MAYAGUEZ	MAYAGUEZ	PR
241410	PONTIFICAL CATHOLIC UNIV OF PUERTO RICO-PONCE	PONCE	PR
197027	UNITED STATES MERCHANT MARINE ACADEMY*	KINGS POINT	NY
243601	UNIVERSIDAD DEL TURABO	GURABO	PR
241739	UNIVERSIDAD METROPOLITANA	CUPY	PR
243577	UNIVERSIDAD POLITECNICA DE PUERTO RICO	HATO REY	PR
240754	UNIVERSITY OF GUAM	MANGILAO	GU
243106	UNIVERSITY OF PUERTO RICO-AGUADILLA UNIV COLLEGE	RAMEY	PR
243115	UNIVERSITY OF PUERTO RICO-ARECIBO	ARECIBO	PR
243133	UNIVERSITY OF PUERTO RICO-BAYAMON	BAYAMON	PR
243142	UNIVERSITY OF PUERTO RICO-CAROLINA REGIONAL COLL	CAROLINA	PR
243179	UNIVERSITY OF PUERTO RICO-HUMACAO	HUMACAO	PR
243197	UNIVERSITY OF PUERTO RICO-MAYAGUEZ	MAYAGUEZ	PR
243212	UNIVERSITY OF PUERTO RICO-PONCE	PONCE	PR
243221	UNIVERSITY OF PUERTO RICO-RIO PIEDRAS CAMPUS	RIO PIEDRAS	PR
243188	UNIVERSITY OF PUERTO RICO-UTUADO	UTUADO	PR
243443	UNIVERSITY OF SACRED HEART	SANTURCE	PR
230737	UTAH VALLEY STATE COLLEGE	OREM	UT
*Graduates of the U.S. Merchant Marine Academy incur an obligation to federal service in return for their education; they may opt to serve this obligation as a reserve officer in any armed force.			

APPENDIX F. CENSUS OF OFFICER SELECTION OFFICERS

Appendix F displays a text version of the census administered to Officer Selection Officers during the period February–July 2002. The sequence in which the questions are numbered is broken, due to a characteristic of the software used to present the census over the internet.

Census of Officer Selection Officers

The following survey takes a comprehensive look at United States Marine Corps officer recruiters' workload, market experience and opinions. As such, it is fairly long and asks you to estimate many numbers, based on your experience. It was designed by Marine officers analyzing the national officer market in support of MCRC, through the Studies and Analysis Division of MCCDC. This survey is part of a larger effort to broaden understanding of the market and its interaction with current officer recruiting structure and processes. The survey should take about 35 minutes to complete. Only those Marine officers currently serving in an Officer Selection Officer billet should participate. As you take this survey, your identity will not be recorded, and only aggregate response information will be provided to MCRC.

The sponsor of this study is Maj B. Wilson, of MCRC. The project officer is LtCol A. Cacciatore, of Studies and Analysis Division, MCCDC. The designer and sponsor of this survey is Maj. W. Hallahan, currently a student in the Operations Research curriculum at the Naval Postgraduate School. Questions about this survey may be sent to wdhallah@nps.navy.mil.

Professional Information. The first set of questions pertains to your career.

4. What is your current rank?

5. To which District are you assigned?

6. Through which program were you commissioned?

7. What is your Primary Occupational Field?

8. Enter your total number of years on active duty. (Round to the nearest year)

9. For how many months have you been recruiting?

a. months of officer recruiting experience
b. months of additional recruiting experience

10. What is your sex?

11. What is your race?

The next section asks questions about your recruiting territory. (For OSOs who share an office: answer the following about your "mini territory." For OSOs assigned to the major bases: skip to question 36.)

13. Please enter the approximate number of campuses in your territory.

a. Number of 4-year postsecondary institutions
b. Number of 2-year postsecondary institutions
c. Number of law schools (include "colleges of law" within the larger university systems.

14. How would you characterize your territory? Mark one answer in each column.

nature of territory	*size*
urban	Too large for one OSO
suburban with some urban centers	About right
rural with scattered cities	Too small for one OSO

15. How many 4-year campuses do you personally visit during a typical week (when you have no assigned TAD OSO)?

16. Estimate the number of hours you spend at your best campus during a typical month (in the absence of a TAD OSO).

17. What portion of your total recruiting effort must you apply to attain your easiest mission area? (Likert scale, 1- 9)

My total effort Half of my time is spent on this mission Almost no effort

18. What portion of your total recruiting effort must you apply to attain your hardest mission area? (Likert scale, 1- 9)

My total effort Half my time is spent on this mission Almost no effort

19. How many of your requests to schedule or accomplish recruiting visits in your territory are unsuccessful? (Likert scale, 1 – 10)

School officials always approve my requests School officials never approve my requests
Half my requests are disapproved

20. How do the following factors affect officer recruiting in your territory? Rate the following on a scale of 1 to 5: 5 = a significant help, 3 = no impact/not sure, 1 = a hindrance.

Marine Corps websites (www.usmc.mil, ocs, etc)
www.marineofficer.com
National image campaign (Superbowl commercials, etc.)
Collateral materials
Region/district events
Economic Recession
Size or other attributes of your pool
Marine Corps Tuition Assistance Program
Funded Flight Programs
Location of your office
Raising Unemployment/less commercial opportunity
Military pay & benefits
The war against terrorism
Active local military bases

21. Rate the following campus characteristics by how important they are in making a campus a good recruiting ground: 10 = critical, 5 = irrelevant, 1 = an interference with OSO activities.

Career center supports military recruiting
ROTC unit affiliated with campus
Many intercollegiate or intramural sports teams
Former Marines or military on faculty or with administration
Campus is near MEPS
School has fairly selective admissions, i.e., most students are mentally qualified
Campus is near a USMCR unit

OSO has a large pool on campus
Most students live far away and commute to campus
Campus is near OSO office
There is a particularly productive society or major field of study on campus
Most students are from wealthy families
Campus is near an active military base
Most students are from middle class families
The school has high tuition costs
Most students are from working class families

22. Have you ever filed a formal report of denied access against a postsecondary institution in your territory?

No
Yes
I have verbally reported to my district headquarters

24. How do you rate the placement officials or career centers at PUBLIC or land grant institutions in your territory?

All are very cooperative
One or two seem to intentionally give better service to nonmilitary recruiters
Many seem to intentionally give better service to nonmilitary recruiters
Almost all try to avoid helping or give the OSO a difficult time

25. How often do students at PUBLIC or land grant campus attempt to disrupt your efforts on campus?

I rarely have trouble on public campuses
I expect some problems, at some public campuses
There are some public campuses at which I face frequent trouble, but I still prospect there
There are some public campuses I avoid because the harassment is too much trouble
I avoid most public campuses in my territory because of harassment

26. How restrictive are the PUBLIC school officials in your territory?

They show little or no discrimination against my efforts
Officials at one or two institutions express desire or attempt to discriminate against my recruiting efforts

Officials at many institutions express desire or attempt to discriminate against my recruiting efforts
Officials at most or all institutions express desire or attempt to discriminate against my recruiting efforts

27. How many 4-year PUBLIC postsecondary institutions or law schools in your territory restrict military, but permit non-military on-campus recruiting?

None
1
2
3
4
More than 4
Not sure

28. How many 4-year PUBLIC postsecondary institutions or law schools in your territory have official policies restricting on-campus recruiting by any agency?

None
1
2
3
4
More than 4
Not sure

The next questions pertain to PRIVATE schools in your territory.

30. How do you rate the placement centers or career centers at PRIVATE institutions in your territory?

All are very cooperative
One or two seem to intentionally give better service to nonmilitary recruiters
Many seem to intentionally give better service to nonmilitary recruiters
Almost all try to avoid helping or give the OSO a difficult time

31. How often do students at PRIVATE campuses attempt to disrupt your efforts on campus?

I rarely have trouble on private campuses
I expect some problems, at some private campuses
There are some private campuses at which I face frequent trouble, but I still prospect there
There are some private campuses I avoid because the harassment is too much trouble
I avoid most private campuses in my territory because of harassment

32. How restrictive are the PRIVATE school officials in your territory?

They show little or no discrimination
Officials at one or two institutions express a desire or attempt to discriminate against my recruiting efforts
Officials at many institutions express desire or attempt to discriminate against my recruiting efforts
Officials at most or all institutions express desire or attempt to discriminate against my recruiting efforts

None
1
2
3
4
More than 4
Not sure

34. How many 4-year PRIVATE postsecondary institutions or law schools in your territory have official policies restricting on-campus recruiting by any agency?

None
1
2
3
4
More than 4
Not sure

You are welcome to enter any additional observations about the nature of your recruiting territory and its effect on OSO success.

The next section asks how OSOs allocate their resources.

37. Divide 100 percentage points to show how much time you spend in the following activities

Interviewing and testing prospects/applicants/poolies
Prospecting on campus or elsewhere
Contacting leads by telephone/email
Pool activities (PT, motivational events)
Administrative or other office work, including processing applications
Traveling
Preparing individuals for OCS (inspect boots, PT, study)
Other

38. Estimate the number of hours you must...

travel each month to and from campuses
travel each month to and from MEPS

39. How often do you prospect at 2-year colleges?

About every month
About every quarter
Once or twice a year
Never

40. How often do you prospect at law schools?

About every month
About every quarter
Once or twice a year
Never

41. How often do you prospect at reserve units?

About every month
About every quarter
Once or twice a year
Never

42. Rank the following activities by how productive they are in finding PLC applicants. (1 = most productive)

Telephone Calls or Emails
Home Visits
Area Canvas
Office Traffic
College Presentations
Display Tables
Other
College Placement Referral
Other

43. Rank the following activities by how productive they are in finding OCC applicants. (1 = most productive)

Telephone Calls or Emails
Home Visits
Area Canvas
Office Traffic
College Presentations
Display Tables
Other
College Placement Referral
Other

The next section asks about your experience with applicants.

45. Why do PLC Ground New Working Applicants fail to contract or ship? (select up to 4 reasons)

Lacks sufficient interest/patience to complete application
Fears ground combat
Fears OCS or otherwise intimidated
Prefers opportunity in commercial sector
Prefers opportunity from other services
Pressured by family, friends or faculty
Lacks US citizenship
Lacks medical qualification/won't pursue medical waiver

Lacks necessary physical fitness
Lacks necessary grade point average
Lacks enough credit hours or stops attending full-time
Believes financial incentives insufficient to cover college debt
Gets injured
Incurs legal trouble/fails background check
Scored too low on ACT/SAT or ASVAB
Believes length of obligation is too long
Fails selection board
Other (enter reason)

46. Why do OCC Ground New Working Applicants fail to contract or ship? (select up to 4 reasons)

Lacks sufficient interest/patience to complete application
Fears ground combat
Fears OCS or otherwise intimidated
Prefers opportunity in commercial sector
Prefers opportunity from other services
Pressured by family, friends or faculty
Lacks US citizenship
Lacks medical qualification/won't pursue medical waiver
Lacks necessary physical fitness
Lacks necessary grade point average
Lacks enough credit hours or stops attending full-time
Believes financial incentives insufficient to cover college debt
Gets injured
Incurs legal trouble/fails background check
Scored too low on ACT/SAT or ASVAB
Believes length of obligation is too long
Fails selection board
Other (enter reason)

47. Why do PLC Pilot/NFO New Working Applicants fail to contract or ship? (select up to 4 reasons)

Lacks sufficient interest/patience to complete application
Fears aerial combat
Fears OCS or otherwise intimidated
Changes mind about flying after flight orientation
Prefers opportunity in commercial sector
Prefers opportunity from other services
Pressured by family, friends or faculty
Lacks US citizenship
Lacks medical qualification/won't pursue medical waiver

Lacks necessary physical fitness
Lacks necessary grade point average
Lacks enough credit hours or stops attending full-time
Believes financial incentives insufficient to cover college debt
Gets injured
Incurs legal trouble/fails background check
Scored too low on AQT/FAR
Scored too low on ACT/SAT or ASVAB
Believes length of obligation is too long
Fails selection board
Other (enter reason)

48. Why do OCC Pilot/NFO New Working Applicants fail to contract or ship? (select up to 4 reasons)

Lacks sufficient interest/patience to complete application
Fears aerial combat
Fears OCS or otherwise intimidated
Changes mind about flying after flight orientation
Prefers opportunity in commercial sector
Prefers opportunity from other services
Pressured by family, friends or faculty
Lacks US citizenship
Lacks medical qualification/won't pursue medical waiver
Lacks necessary physical fitness
Lacks necessary grade point average
Lacks enough credit hours or stops attending full-time
Believes financial incentives insufficient to cover college debt
Gets injured
Incurs legal trouble/fails background check
Scored too low on AQT/FAR
Scored too low on ACT/SAT or ASVAB
Believes length of obligation is too long
Fails selection board
Other (enter reason)

49. Why do PLC Law New Working Applicants fail to contract or ship? (select up to 4 reasons)

Lacks sufficient interest/patience to complete application
Fears combat
Fears OCS or otherwise intimidated
Prefers opportunity in commercial sector
Prefers opportunity from other services

Pressured by family, friends or faculty
Lacks US citizenship
Lacks medical qualification/won't pursue medical waiver
Lacks necessary physical fitness
Lacks necessary grade point average
Lacks enough credit hours or stops attending full-time
Believes financial incentives insufficient to cover college debt
Gets injured
Incurs legal trouble/fails background check
Scored too low on ACT/SAT or ASVAB
Believes length of obligation is too long
Fails selection board
Other (enter reason)

50. Why do OCC Law New Working Applicants fail to contract or ship? (select up to 4 reasons)

Lacks sufficient interest/patience to complete application
Fears combat
Fears OCS or otherwise intimidated
Prefers opportunity in commercial sector
Prefers opportunity from other services
Pressured by family, friends or faculty
Lacks US citizenship
Lacks medical qualification/won't pursue medical waiver
Lacks necessary physical fitness
Lacks necessary grade point average
Lacks enough credit hours or stops attending full-time
Believes financial incentives insufficient to cover college debt
Gets injured
Incurs legal trouble/fails background check
Scored too low on ACT/SAT or ASVAB
Believes length of obligation is too long
Fails selection board
Other (enter reason)

51. Why do New Working Applicants show interest in the PLC Ground program? (select up to 4 reasons)

Can't find a job in their field of study
Dissatisfaction with civilian advancement/promotion opportunity
Dissatisfaction with civilian benefits
Adventure

Patriotism
Travel
Leadership Opportunities
Core Values
Physical Challenge/chance to be outdoors
Chance to be part of military history
Interest in military technology (i.e., aircraft, rifles, armor)
Dissatisfied with civilian life but have difficulty expressing why
Family Tradition
Other

52. Why do New Working Applicants show interest in the OCC Ground program? (select up to 4 reasons)

Can't find a job in their field of study
Dissatisfaction with civilian advancement/promotion opportunity
Dissatisfaction with civilian benefits
Adventure
Patriotism
Travel
Leadership Opportunities
Core Values
Physical Challenge/chance to be outdoors
Chance to be part of military history
Interest in military technology (i.e., aircraft, rifles, armor)
Dissatisfied with civilian life but have difficulty expressing why
Family Tradition
Other

53. Why do New Working Applicants show interest in the PLC Pilot and NFO programs? (select up to 4 reasons)

Can't find a job in their field of study
Dissatisfaction with civilian advancement/promotion opportunity
Dissatisfaction with civilian benefits
Adventure
Patriotism
Travel
Leadership Opportunities
Core Values
Physical Challenge/chance to be outdoors
Chance to be part of military history
Interest in military technology (i.e., aircraft, rifles, armor)

Dissatisfied with civilian life but have difficulty expressing why
Family Tradition
Other

54. Why do New Working Applicants show interest in the OCC Pilot and NFO programs? (select up to 4 reasons)

Can't find a job in their field of study
Dissatisfaction with civilian advancement/promotion opportunity
Dissatisfaction with civilian benefits
Adventure
Patriotism
Travel
Leadership Opportunities
Core Values
Physical Challenge/chance to be outdoors
Chance to be part of military history
Interest in military technology (i.e., aircraft, rifles, armor)
Dissatisfied with civilian life but have difficulty expressing why
Family Tradition
Other

55. Why do New Working Applicants show interest in the PLC law program? (select up to 4 reasons)

Can't find a job in their field of study
Dissatisfaction with civilian advancement/promotion opportunity
Dissatisfaction with civilian benefits
Adventure
Patriotism
Travel
Leadership Opportunities
Core Values
Physical Challenge/chance to be outdoors
Chance to be part of military history
Interest in military technology (i.e., aircraft, rifles, armor)
Dissatisfied with civilian life but have difficulty expressing why
Family Tradition
Other

56. Why do New Working Applicants show interest in the OCC law program? (Select up to 4 reasons)

Can't find a job in their field of study
Dissatisfaction with civilian advancement/promotion opportunity
Dissatisfaction with civilian benefits
Adventure
Patriotism
Travel
Leadership Opportunities
Core Values
Physical Challenge/chance to be outdoors
Chance to be part of military history
Interest in military technology (i.e., aircraft, rifles, armor)
Dissatisfied with civilian life but have difficulty expressing why
Family Tradition
Other

57. Distribute 100 percentage points between the following statements.

percent of PLC applicants initiate contact with the OSO
percent of PLC applicants are first contacted by the OSO

58. Distribute 100 percentage points between the following statements.

percent of OCC applicants initiate contact with the OSO
percent of OCC applicants are first contacted by the OSO

You are welcome to enter any additional observations about reasons applicants follow through, or fail to ship.

The next section asks you to compare the ease with which you achieved mission, by program, LAST YEAR (FY2001).

61. Rate the following mission areas by how difficult they were to attain last year (FY 2001): 1 = fairly easy; 5 = fairly difficult. * Place the letter "n" beside any category for which you did not recruit.

PLC (Ground)
PLC (Naval Aviator)
PLC (Law)
OCC (Ground)
OCC (Aviation Officer Candidate)
OCC (Law)

62. Rate the following mission areas by how difficult they have been to attain last year (FY 2001): 1 = fairly easy; 5 = fairly difficult, * Place the letter "n" beside any category for which you did not recruit.

PLC (male)
PLC (female)
OCC (male)
OCC (female)

63. Select the component that was MOST DIFFICULT to attain last year (FY 2001).

Ground
Air
Law
They were about the same
I didn't recruit last year

64. Select the component that was EASIEST to attain last year (FY 2001).

Ground
Air
Law
They were about the same
I didn't recruit last year

65. Select the diversity category and program of that category that was HARDEST to attain last year (FY 2001). (i.e., "I had the easiest time finding qualified Hispanics interested in the PLC program last year.")

Hardest diversity category...	Hardest program for that category..
African-American	OCC
Hispanic	PLC
Other	

66. Select the diversity category and program of that category that was EASIEST to attain last year (FY 2001). (i.e., "I had the easiest time finding qualified Hispanics interested in the PLC program last year.")

Easiest diversity category...	Easiest program for that category...
African-American	OCC
Hispanic	PLC
Other	

The next section asks you to compare the ease with which you are achieving mission, by program, for THIS YEAR (FY02).

68. Rate the following mission areas by how difficult they have been to attain this year (FY 2002): 1 = fairly easy; 5 = fairly difficult. * Place the letter "n" beside any category for which you did not recruit.

PLC (Ground)
PLC (Naval Aviator)
PLC (Naval Flight Officer)
PLC (Law)
OCC (Ground)
OCC (Aviation Officer Candidate)
OCC (Naval Flight Officer)
OCC (Law)

69. Rate the following mission areas by how difficult they have been to attain this year (FY 2002): 1 = fairly easy; 5 = fairly difficult. * Place the letter "n" beside any category for which you did not recruit.

PLC (male)
PLC (female)
OCC (male)
OCC (female)

70. Select the component that seems MOST DIFFICULT to attain this year (FY 2002).

Ground
Pilot
NFO
Law
They are about the same

71. Select the component that seems EASIEST to attain this year (FY 2002).

Ground
Pilot
NFO
Law
They are about the same

72. Select the diversity category and program for that category that seems HARDEST to attain this year (FY 2002).

Hardest diversity category...	Hardest program for that category...
African-American	OCC
Hispanic	PLC
Other	

73. Select the diversity category and program of that category that seems EASIEST to attain this year (FY 2002). (i.e., "I had the easiest time finding qualified Hispanics interested in the PLC program last year.")

Easiest diversity category...	Easiest program for that category...
African-American	OCC
Hispanic	PLC
Other	

You are welcome to enter comments about missioning.

The next section asks your opinion about the competition you face for qualified applicants.

76. How to you rate the competition for qualified applicants from the USMC Reserves and Enlisted Recruiting? (Likert Scale 1 – 5)

Strong competitor Usually irrelevant

77. How to you rate the competition for qualified applicants from ROTC and other service officer recruiting? (Likert Scale 1 - 5)

Strong competitor Usually irrelevant

78. How to you rate the competition for qualified applicants from other services enlisted recruiting efforts? (Likert Scale 1 – 5)

Strong competitor Usually irrelevant

79. How to you rate the competition for qualified applicants from the commercial sector? (Likert Scale 1 – 5)

Strong competitor Usually irrelevant

80. How to you rate the competition for qualified applicants from other federal and state agencies (i.e., FBI)? (Likert Scale 1 – 5)

Strong competitor Usually irrelevant

You are welcome to enter observations about the competition you face from external agencies.

The next section asks some general questions about your beliefs and experiences.

83. In general, how does recruiting FEMALE compare to recruiting male PLC applicants?

Much easier than recruiting male PLC applicants
Somewhat easier
About the same
Somewhat more difficult
Much more difficult

84. In general, how does recruiting FEMALE compare to recruiting male OCC applicants?

Much easier than recruiting male OCC applicants
Somewhat easier
About the same
Somewhat more difficult
Much more difficult

85. Which missioning method sends better candidates to OCS?

Submission (credit for contracts)
Shipping (credit for producing candidates training at OCS)
I have noted no significant difference
I don't know/I didn't recruit last year

86. Under which missioning method is an OSO more likely to complete a successful tour?

Submission
Shipping
I have noted no significant difference
I don't know/I didn't recruit last year

87. Rank the following sources of leads on prospective new PLC applicants. (1 = the most productive source)

TAD OSO
Poolie Referral
List
Local Source
Area Canvas
Walk in/Phone in
Enlisted Recruiter Referral
College Placement Referral
Other sources not listed here

88. Rank the following sources of leads on prospective new OCC applicants. (1 = the most productive source)

TAD OSO
Poolie Referral
List
Local Source
Area Canvas
Walk in/Phone in
Enlisted Recruiter Referral
College Placement Referral
Other sources not listed here

89. When you brief back candidates upon their return from PLC Jr, how have their views of the Marine Corps changed? Divide 100 percentage points among the following:

percent are more motivated to pursue a Marine commission
percent are generally unchanged by the course
percent are less motivated to pursue a Marine commission

90. When you brief back LAW candidates upon their return from OCS, how have their views of the Marine Corps changed?

I haven't briefed back any law candidates following their successful completion of OCS
They are generally more positive about practicing law in the Marine Corps
Their views of the Marine Corps generally don't change
They are generally more negative about practicing law in the Marine Corps

91. Mark any of the following characteristics that seem to distinguish significant numbers of applicants from the rest of their student body.

Family member served	Is married/plans to marry soon
Current service in reserves/national guard	Plans to stay single
Prior enlisted service	Certain size of school
Certain college majors	Certain control of school (public, private)
Intercollegiate athlete	There are no significant characteristics; as a group they are generally indistinguishable from the student body
Certain extracurricular activity/hobby	Other (enter characteristic)
Certain level of family income	

92. Why do poolies quit? (select up to 4 reasons)

Were committed, but lose interest/patience to complete program
Fear combat
Fear returning to OCS
Prefer to do something else with their summer
Prefer opportunity in commercial sector
Prefer opportunity from other services
Pressured by family, friends or faculty
Can't/won't maintain necessary physical fitness
Can't/won't maintain necessary grade point average
Can't/won't get enough credit hours, attend full-time or graduate
Believe financial incentives insufficient to cover college debt
Get injured
Incur legal trouble
Believe length of obligation is too long
Have a moral or political change of heart
They attended PLC Jr. more out of curiosity, boredom or challenge than a commitment to a commission
Other (enter reason)

Personal Information. The following questions are optional.

94. How satisfied are you with your time on recruiting duty?

Generally Satisfied
Could Take it or Leave it
Generally Dissatisfied

95. Which of the following best describe your time on recruiting duty?

It will help achievement of my goals
It won't matter to achievement of my goals
It will hinder achievement of my goals

All categories were fair and achievable
One or two missions were not realistic
Three or four missions were unrealistic
More than four missions were unrealistic
No category was achievable in my territory

97. Based on the characteristics of your assigned schools and the resources of your office, how fair do you consider your assigned mission this year (in FY2002)?

All categories were fair and achievable
One or two missions were not realistic
Three or four missions were unrealistic
More than four missions were unrealistic
No category was achievable in my territory

We welcome any additional comments you have on the project or this survey.

Thank you for taking time to answer this survey. Good Luck with Recruiting.

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APPENDIX G. PROPENSITY STUDY DATA

This appendix presents data used in the search for an estimator of propensity to enter Marine Officer commissioning programs.

Table 23 presents the variables considered in the classification tree and agglomerative nesting techniques.

Variable Name	**Type**	**Range**	**Remarks**
ContractSchedDiff*	Continuous	3-1390	Difference, in days, between date applicant signed contract and date the applicant agreed to report to OCS
Sex	Set	Male, Female	
Race	Set	Black, Hispanic, Other, White	USMC race category
MaritalStatus	Binary		Indicates whether the applicant was married or not
Program	Set	PLC Juniors, PLC Combined, OCC	Program to which the applicant was approved to attend
Component	Set	Ground, Pilot, NFO, Law	Component to which the applicant was approved to attend
ActyRctFm	Set	Area Canvass, College Presentation, etc.	The action that generated a lead to this applicant

ScrRctFm	Set	College Placement Referral, Poolie Referral, etc.	The location that generated the lead
HORST	Set	50 states, DC, Puerto Rico	Home of Record State
CURRST	Set	50 states, DC, Puerto Rico	State of residence at time of application
EL	Continuous	104-140	EL portion score from ASVAB; 4,185 missing values
EL Quartile	Set	1-4	
SAT**	Continuous	810-1600	SAT combined score; scores prior to 1996 are converted; 3,317 missing values
SATQuartile	Set	1-4	
ACT	Continuous	36-66	ACT math + English score; 6,893 missing values
ACTQuartile	Set	1-4	
LSAT	Continuous	131-174	LSAT Score; 6,779 missing values
LSATQuartile	Set	1-4	
HighMentalQuartile	Set	1-4	The highest quartile in which the applicant scored; 240 missing values
GPA	Continuous	1.09-4.00	College grade point average recorded at time of application; 36 missing values
GPAQuartile	Set	1-4	
PFT	Continuous	139-300	Physical fitness test score recorded by OSO; 47 missing values
PFTQuartile	Set	1-4	
HasWaiver	Binary		Indicates if the applicant received at least one waiver; 3998 of 7063 had such a waiver.
NumWaivers	Set	1-3	Number of granted waivers

MoralWaiver	Binary		Indicates if at least one of the waivers was granted for moral reasons: drug use, traffic stops, legal convictions, etc. 3037 of 7063 had such a waiver.
PhysWaiver	Binary		Indicates if at least one of the waivers was granted for a physical condition; 1139 of 7063 had such a waiver.
Drop	Binary		Indicates if the application was returned or denied by district or HQMC, or if the applicant has a MCRC or OCS drop code. An applicant who dropped, then returned to OCS to earn a commission is considered a drop.
DropNotPhys	Binary		Indicates if the applicant was dropped by MCRC or OCS for unsatisfactory performance or on applicant request; 2341 of 7063 were such drops
DropType	Set	Unsat, DOR, NPQ	Type of reason a failure was dropped from the program; 3232 of 7063 records were drops
District	Set	1,4,6,8,9,12	District that submitted the application
RecruitSta	Set		Recruiting Station that submitted the application
Region	Set	Middle Atlantic, East North Central, etc.	US Census Bureau region from which the applicant applied
Carnegie	Set	Bachelor's, Research University I, etc.	Carnegie classification of the type of school from which the applicant applied

BarronsGroup	Set	Highly Selective, Selective, etc.	Barron's College Admissions Guide measure of admissions selectiveness of school from which applicant applied
Control	Set	Public, Private Not for Profit, Private For Profit	Type of control of institution from which applicant applied
QCPTot	Continuous	5 - 3870	Total QCP of school from which applicant applied, as determined by Jareb-Parker model; 546 missing values
EnrTot	Continuous	400 - 17400	Male full-time enrollment of school from which applicant applied, as determined by 1997 IPEDS data
QualRate	Continuous	.045 – 1.0	Proportion of students in applicant school expected to be mentally qualified, as determined by model; 546 missing values.

*Three fields in ARMS provided the information necessary to measure contract difference: Contract Date, Scheduled Ship Date, and Date-to-OCS. The Scheduled Ship Date is the date that the OSO, candidate and HQMC agree upon for planned shipment to OCS. As it measures an initial level of commitment at time of contract, it may be the better measure of propensity. The actual date of reporting to OCS differs in cases where a candidate cannot meet the obligation due to medical, academic or personal reasons, and in cases where greater-than-expected PLC accessions decrease the number of required OCC accessions. In such instances, committed OCC candidates are sometimes told that their orders to OCS have been postponed. As the difference between contract date and report date measures the time a candidate has had to prepare, it may prove the better predictor of success in the commissioning process.

**To improve the diagnostics of this propensity model, other factors were considered as well. Applying SQL Queries in Microsoft Access unraveled test scores contained in ARMS. A score between 130 and 180 in the MATH, VERB or COMB

column was assumed to be a LSAT score. A score between 11 and 36 in both the MATH and ***VERB*** columns were assumed to be ACT Math and ***English*** scores. A score between 400 and 1,800 in the COMB column was assumed to be a SAT (combined) score. Scores between 200 and 600 in both the MATH and VERB columns were assumed to be SAT scores; in the absence of a COMB score, these two were summed. All scores within the EL column fell within the range of EL scores, but this range overlaps the lower end of the LSAT. This study assumes that the EL column has integrity, based on the fairly consistent pattern of using the MATH, VERB and COMB fields for other scores, by certain districts during certain eras. 387 presumptive LSAT scores, 7,686 EL, 283 presumptive ACT, and 26 raw SAT (combined) scores were obtained in this manner. The number of ACT scores should be higher, but the MPPM directs that an applicant's ACT score be converted, using the 1989 concordance table, and entered as SAT equivalents. So an untold number of SAT scores in the data base were actually converted ACT scores; we expect, due to the 1995 recenter, that most scores converted in this fashion after 1995 will as a group be 20 to 30 points lower than the group of scores reported by SAT test takers, because the concordance table predates the recenter.

The SAT (combined) score proved problematic. Figure 32 shows that the Mean SAT (combined) score among applicants climbed approximately 30 points during the years 1997–99, a magnitude which correlates nicely with the effect of recenter. Additionally, the PLC scores climbed immediately, while a rise in test scores among older applicants in the OCC cohort lagged by two years, suggesting that the effect of recentered test scores was significant on the population.

Before analyzing the database of applicant records, this disparity between SAT score records was addressed by recentering those scores perceived to have been taken on the older scale. The sample was broken into three sets: those born prior to 1 Sept 1977 (and thus likely graduated high school before the recentering), those born after 1 Jun 1979 (who likely took the recentered test), and those in-between. Those born in between were assumed to have taken the old test if they were admitted on a FY 97 or earlier FY quota. Those in the old test set then had their scores adjusted, if available. Those in the

in-between set were randomly selected; 1/5 had their scores adjusted. This proportion is based on the latest College Board summary of test takers, which shows 1 of 5 male test takers was a junior in high school; nearly the rest were seniors.

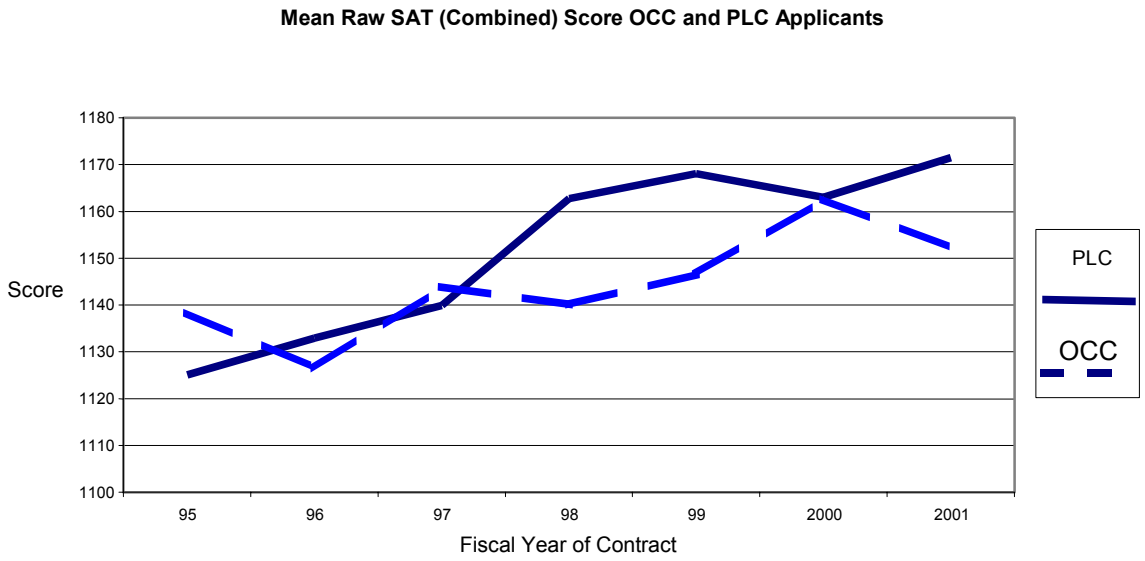

Figure 32. Mean SAT (Combined) Scores of OCC and PLC Applicants 1996–2001 (Created by Author)

APPENDIX H. GLOSSARY OF TERMS

This glossary presents definitions obtained from the National Council of Education Statistics (NCES) *Digest of Education Statistics 2000,* the NCES Integrated Postsecondary Education Data System *Glossary (1995),* and from the Carnegie Foundation *The 2000 Carnegie Classification System*.

Academic Year

The period of time generally extending from September to June; usually equated to two semesters or trimesters, three quarters, or the period covered by a 4-1-4 plan.

Accrediting Agencies

Agencies that establish operating standards for educational or professional institutions and programs, determine the extent to which the standards are met, and publicly announce their findings.

Admissions Test Scores

Scores on standardized admissions tests or special admissions tests.

American College Testing Program (ACT)

The ACT assessment program measures educational development and readiness to pursue college-level coursework in English, mathematics, natural science, and social studies. Student performance on the tests does not reflect innate ability and is influenced by a student's educational preparedness.

Associate's Colleges

These institutions offer associate's degrees and certificate programs but, with few exceptions, award no baccalaureate degrees. This group includes institutions where, during the period studied, bachelor's degrees represented less than 10 percent of all undergraduate awards.

Associate's Degree

An award that normally requires at least 2 but less than 4 years of full-time equivalent college work.

Bachelor's Degree

An award (baccalaureate or equivalent degree, as determined by the Secretary, U.S. Department of Education) that normally requires at least 4 but not more than 5 years of full-time equivalent college-level work. This includes all bachelor's degrees conferred in a 5-year cooperative (work-study plan) program. A cooperative plan provides for alternate class attendance and employment in business, industry, or government; thus, it allows students to combine actual work experience with their college studies. Also, includes bachelor's degrees in which the normal 4 years of work are completed in 3 years.

Baccalaureate Colleges

> ***Baccalaureate Colleges—Liberal Arts***: These institutions are primarily undergraduate colleges with major emphasis on baccalaureate programs. During the period studied, they awarded at least half of their baccalaureate degrees in liberal arts fields.
>
> ***Baccalaureate Colleges—General***: These institutions are primarily undergraduate colleges with major emphasis on baccalaureate programs. During the period studied, they awarded less than half of their baccalaureate degrees in liberal arts fields.
>
> ***Baccalaureate/Associate's Colleges***: These institutions are undergraduate colleges where the majority of conferrals are below the baccalaureate level (associate's degrees and certificates). During the period studied, bachelor's degrees accounted for at least ten percent of undergraduate awards.

Carnegie Classification
The 2000 Carnegie Classification includes all colleges and universities in the United States that are degree-granting and accredited by an agency recognized by the U.S. Secretary of Education. The 2000 edition classifies institutions based on their degree-granting activities from 1995-96 through 1997-98.

CIP (Classification of Instructional Programs)
An NCES publication that provides a numerical classification and standard terminology for secondary and postsecondary instructional programs.

CIP Code
A six-digit code in the form xx.xxxx that identifies instructional program specialties within educational institutions.

College
A postsecondary school which offers general or liberal arts education, usually leading to an associate, bachelor's, master's, doctor's, or first-professional degree. Junior colleges and community colleges are included under this terminology.

Credit Hour
A unit of measure representing an hour (50 minutes) of instruction over a 15-week period in a semester or trimester system or a 10-week period in a quarter system. It is applied toward the total number of hours needed for completing the requirements of a degree, diploma, certificate, or other formal award.

Degree
An award conferred by a college, university, or other postsecondary education institution as official recognition for the successful completion of a program of studies.

Degree-granting institutions
Postsecondary institutions that are eligible for Title IV federal financial aid programs and that grant an associate's or higher degree. For an institution to be eligible to participate in Title IV financial aid programs it must offer a program of at least 300 clock hours in length, have accreditation recognized by the U.S. Department of Education, have been in business for at least 2 years, and have signed a participation agreement with the Department.

Degree-seeking Students
Students enrolled in courses for credit who are recognized by the institution as seeking a degree or formal award. At the undergraduate level, this is intended to include students enrolled in vocational or occupational programs.

Diploma
A formal document certifying the successful completion of a prescribed program of studies.

Doctorate-granting Institutions

***Doctoral/Research Universities—Extensive*:** These institutions typically offer a wide range of baccalaureate programs, and they are committed to graduate education through the doctorate. During the period studied, they awarded 50 or more doctoral degrees per year across at least 15 disciplines.

***Doctoral/Research Universities—Intensive*:** These institutions typically offer a wide range of baccalaureate programs, and they are committed to graduate education through the doctorate. During the period studied, they awarded at least ten doctoral degrees per year across three or more disciplines, or at least 20 doctoral degrees per year overall.

FICE Code
A 6-digit identification code originally created by the Federal Interagency Committee on Education. The code was used to identify all schools doing business with the Office of Education during the early sixties; it is now used in IPEDS to identify institutions that are accredited at the college level by an agency recognized by the Secretary, U.S. Department of Education. These are the traditional institutions of higher education, formerly surveyed under the Higher Education General Information Surveys (HEGIS), plus any schools that are newly accredited institutions of higher education. IPEDS uses FICE codes to track these institutions in order to maintain historical trends that began in the mid-sixties.

First-professional degree
A degree that signifies both completion of the academic requirements for beginning practice in a given profession and a level of professional skill beyond that normally required for a bachelor's degree. This degree usually is based on a program requiring at least 2 academic years of work prior to entrance and a total of at least 6 academic years of work to complete the degree program, including both prior-required college work and the professional program itself. By NCES definition, first-professional degrees are awarded in the fields of dentistry (D.D.S. or D.M.D.), medicine (M.D.), optometry (O.D.), osteopathic medicine (D.O.), pharmacy (D.Phar.), podiatric medicine (D.P.M.), veterinary medicine (D.V.M.), chiropractic (D.C. or D.C.M.), law (J.D.), and theological professions (M.Div. or M.H.L.).

First-time First-year Student
A student attending any institution for the first time at the undergraduate level. Includes students enrolled in the fall term who attended college for the first time in the prior summer term. Also includes students who entered with advanced standing (college credits earned before graduation from high school).

First-time Freshman
An entering freshman who has never attended any college. Includes students enrolled in the fall term who attended college for the first time in the prior summer term. Also includes students who entered with advanced standing (college credits earned before graduation from high school).

First-time Student
A student attending any institution for the first time at the level enrolled. Includes students enrolled in the fall term who attended a postsecondary institution for the first time at the same level in the prior summer term. Also includes students who entered with advanced standing (college credit earned before graduation from high school).

First-year Student
A student who has completed less than the equivalent of 1 full year of undergraduate work; that is, less than 30 semester hours (in a 120-hour degree program) or less than 900 contact hours.

Fourth Year and Beyond
An undergraduate student who has completed the equivalent of 3 years of full-time undergraduate work; that is, at least 90 semester hours in a 120-hour degree program.

Freshman
A first-year undergraduate student.

Full-time Student
Undergraduate - A student enrolled for 12 or more semester credits, or 12 or more quarter credits, or 24 or more contact hours a week each term.

Geographic Region
One of the regions or divisions used by the U.S. Bureau of the Census in Current Population Survey tabulations, as follows:

Northeast	**Midwest**	**South**	**West**
(New England)	(East North Central)	(South Atlantic)	(Mountain)
Maine	Ohio	Delaware	Montana
New Hampshire	Indiana	Maryland	Idaho
Vermont	Illinois	District of Columbia	Wyoming
Massachusetts	Michigan	Virginia	Colorado
Rhode Island	Wisconsin	West Virginia	New Mexico
Connecticut		North Carolina	Arizona
		South Carolina	Utah
		Georgia	Nevada
		Florida	
(Middle Atlantic)	(West North Central)	(East South Central)	(Pacific)
New York	Minnesota	Kentucky	Washington
New Jersey	Iowa	Tennessee	Oregon
Pennsylvania	Missouri	Alabama	California
	North Dakota	Mississippi	Alaska
	South Dakota		Hawaii
	Nebraska		
	Kansas		
		(West South Central)	
		Arkansas	
		Louisiana	
		Oklahoma	
		Texas	

HBCU
Historically Black Colleges and Universities. Accredited institutions of higher education established prior to 1964 with the principal mission of educating Black Americans. Federal regulations (20 USC 1061 (2)) allow for certain exceptions to the founding date.

HEGIS
The Higher Education General Information Survey system conducted by the National Center for Education Statistics between 1966 and 1985. A system comprising several surveys of institutions that are accredited at the college level by an agency recognized by the Secretary, U.S. Department of Education. These surveys included institutional characteristics, enrollment, degrees conferred, salaries, employees, financial statistics, libraries, and others. HEGIS surveys were sent to approximately 3,400 accredited institutions of higher education.

Higher education institutions (traditional classification)

4-year institution
An institution legally authorized to offer and offering at least a 4-year program of college-level studies wholly or principally creditable toward a baccalaureate degree. In some tables, a further division between universities and other 4-year institutions is made. A "university" is a postsecondary institution which typically comprises one or more graduate professional schools. For purposes of trend comparisons in this volume, the selection of universities has been held constant for all tabulations after 1982. "Other 4-year institutions" would include the rest of the nonuniversity 4-year institutions.

2-year institution
An institution legally authorized to offer and offering at least a 2-year program of college-level studies which terminates in an associate degree or is principally creditable toward a baccalaureate degree. Also includes some institutions that have a less than 2-year program, but were designated as institutions of higher education in the Higher Education General Information Survey.

Integrated Postsecondary Education Data System (IPEDS)
IPEDS is the core postsecondary education data collection program in the U.S. Department of Education's National Center for Education Statistics (NCES). It was designed to help NCES meet its mandate to report full and complete statistics on the condition of postsecondary education in the United States. It is a single, comprehensive data collection system developed to encompass all institutions and organizations whose primary purpose is to provide postsecondary education. The IPEDS system is built around a series of interrelated surveys to collect institution-level data in such areas as enrollment, program completions, faculty, staff, finance, and libraries.

Master's Colleges and Universities

Master's Colleges and Universities I
These institutions typically offer a wide range of baccalaureate programs, and they are committed to graduate education through the master's degree. During the period studied, they awarded 40 or more master's degrees per year across three or more disciplines.

Master's Colleges and Universities II
These institutions typically offer a wide range of baccalaureate programs, and they are committed to graduate education through the master's degree. During the period studied, they awarded 20 or more master's degrees per year.

NCES
The National Center for Education Statistics, which is the statistical branch of the Office of Educational Research and Improvement, a principal operating component of the U.S. Department of Education.

Nonresident Alien
A person who is not a citizen or national of the United States and who is in this country on a visa or temporary basis and does not have the right to remain indefinitely.

Official Fall Reporting Date
The date (in the fall) on which an institution must report fall enrollment data to either the State, its board of trustees or governing board, or some other external governing body.

Open Admission
Admission policy whereby the school will accept any student who applies.

Outlying Areas
Includes American Samoa, the Federated States of Micronesia, Guam, the Marshall Islands, the Northern Mariana Islands, Palau, Puerto Rico, and the Virgin Islands.

Part-time Student
Undergraduate - A student enrolled for either 11 semester credits or less, or 11 quarter credits or less, or less than 24 contact hours a week each term.

Persistence
The act of attending full time at the same campus for at least 8 months during the year.

Postbaccalaureate Enrollment
The number of graduate and first-professional students working towards advanced degrees and of students enrolled in graduate-level classes but not enrolled in degree programs.

Postsecondary Education
The provision of a formal instructional program whose curriculum is designed primarily for students who are beyond the compulsory age for high school. This includes programs whose purpose is academic, vocational, and continuing professional education, and excludes avocational and adult basic education programs.

Postsecondary Education Institution
An institution which has as its sole purpose, or one of its primary missions, the provision of postsecondary education. Postsecondary education is the provision of a formal instructional program whose curriculum is designed primarily for students beyond the compulsory age for high school. This includes programs whose purpose is academic,

vocational, and continuing professional education, and excludes avocational and adult basic education programs.

Private Institution
An educational institution controlled by a private individual(s) or by a nongovernmental agency, usually supported primarily by other than public funds, and operated by other than publicly elected or appointed officials.

Private Nonprofit Institution
A private institution in which the individual(s) or agency in control receives no compensation, other than wages, rent, or other expenses for the assumption of risk. These include both independent nonprofit schools and those affiliated with a religious organization.

Public Institution
An educational institution whose programs and activities are operated by publicly elected or appointed school officials and which is supported primarily by public funds.

Quarter Calendar System
A calendar system in which the academic year consists of 3 sessions called quarters of about 12 weeks each. The range may be from 10 to 15 weeks. There may be an additional quarter in the summer.

Racial/ethnic group
Classification indicating general racial or ethnic heritage based on self-identification, as in data collected by the U.S. Bureau of the Census or on observer identification, as in data collected by the Office for Civil Rights. These categories are in accordance with the Office of Management and Budget standard classification scheme presented below:

> ***White***
> A person having origins in any of the original peoples of Europe, North Africa, or the Middle East. Normally excludes persons of Hispanic origin except for tabulations produced by the U.S. Bureau of the Census.
>
> ***Black***
> A person having origins in any of the black racial groups in Africa. Normally excludes persons of Hispanic origin except for tabulations produced by the U.S. Bureau of the Census.
>
> ***Hispanic***
> A person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race.

Asian or Pacific Islander
A person having origins in any of the original peoples of the Far East, Southeast Asia, the Indian subcontinent, or the Pacific Islands. This area includes, for example, China, India, Japan, Korea, the Philippine Islands, and Samoa.

American Indian or Alaskan Native
A person having origins in any of the original peoples of North America and maintaining cultural identification through tribal affiliation or community recognition.

Resident Alien (and Other Eligible Non-citizens)
A person who is not a citizen or national of the United States and who has been admitted as a legal immigrant for the purpose of obtaining permanent resident alien status (and who holds either an alien registration card (Form I-551 or I-151), a Temporary Resident Card (Form I-688), or an Arrival-Departure Record (Form I-94) with a notation that conveys legal immigrant status such as Section 207 Refugee, Section 208 Asylee, Conditional Entrant Parolee or Cuban-Haitian).

SAT (Scholastic Aptitude Test)
An examination administered by the Educational Testing Service and used to predict the facility with which an individual will progress in learning college-level academic subjects.

Second-year Student
A student who has completed the equivalent of 1 year of full-time undergraduate work; that is, at least 30 semester hours but less than 60 semester hours (in a 120-hour program) or more than 900 contact hours but less than 1,800 contact hours.

Sector
One of nine institutional categories resulting from dividing the universe according to control and level. Control categories are public, private nonprofit, and private for-profit. Level categories are 4-year and higher (4 year), 2-but-less-than 4-year (2 year), and less than 2-year. For example: public, 4-year institutions; public, 2-year; etc.

Semester Calendar System
A calendar system that consists of two semesters during the academic year with about 16 weeks for each semester of instruction. There may be an additional summer session.

Specialized Institutions
These institutions offer degrees ranging from the bachelor's to the doctorate, and typically award a majority of degrees in a single field. The list includes only institutions that are listed as separate campuses in the 2000 Higher Education Directory. Specialized institutions include:

Theological seminaries and other specialized faith-related institutions: These institutions primarily offer religious instruction or train members of the clergy.

Medical schools and medical centers: These institutions award most of their professional degrees in medicine. In some instances, they include other health professions programs, such as dentistry, pharmacy, or nursing.

Other separate health profession schools: These institutions award most of their degrees in such fields as chiropractic, nursing, pharmacy, or podiatry.

Schools of engineering and technology: These institutions award most of their bachelor's or graduate degrees in technical fields of study.

Schools of business and management: These institutions award most of their bachelor's or graduate degrees in business or business-related programs.

Schools of art, music, and design: These institutions award most of their bachelor's or graduate degrees in art, music, design, architecture, or some combination of such fields.

Schools of law: These institutions award most of their degrees in law.

Teachers colleges: These institutions award most of their bachelor's or graduate degrees in education or education-related fields.

Other specialized institutions: Institutions in this category include graduate centers, maritime academies, military institutes, and institutions that do not fit any other classification category.

Standardized Admissions Tests
Tests prepared and administered by an agency independent of any postsecondary education institution, for purposes of making available to prospective students, information about the students' academic qualifications relative to a national sample. Examples are the Scholastic Aptitude Test (SAT) and the American College Testing (ACT).

Third-year Student
A student who has completed the equivalent of 2 years of full-time undergraduate work; that is, at least 60 semester hours but less than 90 semester hours (in a 120-hour program).

Transfer Student
A student entering the reporting institution for the first time but known to have previously attended a postsecondary institution at the same level (e.g., undergraduate, graduate). The student may transfer with or without credit.

Tribal Colleges and Universities
These colleges are, with few exceptions, tribally controlled and located on reservations. They are all members of the American Indian Higher Education Consortium.

Undergraduate
A student enrolled in a 4- or 5-year bachelor's degree program, an associate's degree program, or a vocational or technical program below the baccalaureate.

UNITID Code
Unique identification number assigned to postsecondary institutions surveyed through the Integrated Postsecondary Education Data System (IPEDS).

University
An institution of higher education consisting of a liberal arts college, a diverse graduate program, and usually two or more professional schools or faculties and empowered to confer degrees in various fields of study. For purposes of maintaining trend data in this publication, the selection of university institutions has not been revised since 1982.

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